4.0 ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This chapter discusses the potential environmental consequences associated with the Proposed Action and the No-Action Alternative. To provide the context in which potential environmental impacts may occur, discussions of potential changes to the local communities, including employment and population, land use and aesthetics, transportation networks, and public utility systems, are included in this chapter. In addition, issues related to current and future management of hazardous materials and wastes and health and safety practices are discussed. Impacts to the physical and natural environment are evaluated for geology and soils, water resources, air quality, noise, orbital debris, biological resources, and cultural resources. An environmental justice analysis was conducted to examine potential disproportionately high and adverse impacts to low-income and minority populations. Environmental impacts may occur as a direct result of the proposed activities or as an indirect result of changes within the local communities.

Each section within this chapter discusses a separate resource area and describes the potential impacts resulting from implementation of the Proposed Action and No-Action Alternative. Mitigation measures are described, where applicable. The Proposed Action includes a discussion of the impacts of implementing the Concept A, Concept B, or Concept A/B EELV launch programs at Cape Canaveral AS and Vandenberg AFB. Each section also includes an analysis of the impacts resulting from the No-Action Alternative, which is the continuation of current launch vehicle programs to meet the requirements of government spacelift transportation programs under the NMM.

Means of mitigating substantial adverse environmental impacts that may result from implementation of the Proposed Action or No-Action Alternative are discussed as required by NEPA. Potential mitigation measures are described for those components likely to experience substantial and adverse changes under the Proposed Action or No-Action Alternative. Potential mitigation measures depend upon the particular resource affected. In general, however, mitigation measures are defined in CEQ regulations as actions that include:

- Avoiding the impact altogether by not taking an action or by not performing certain aspects of the action

- Minimizing the impacts by limiting the degree or magnitude of the action and its implementation

- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment

- Reducing or eliminating the impact over time through preservation and maintenance operations during the life of the action

- Compensating for the impact by replacing or providing substitute resources or environments.

Mitigation measures that are clearly required by law or standard industry practices are generally considered to be part of the Proposed Action. Additional potential mitigation measures beyond those clearly required by law or standard practices are described under each resource area, where impacts have been identified. Such measures include those the Air Force could implement or those discretionary mitigations or choices available to other governmental bodies (such as permit conditions, etc.).

4.2 COMMUNITY SETTING

This section describes direct and indirect changes in employment and population and effects on the socioeconomic environment for the Proposed Action and No-Action Alternative.

4.2.1 Proposed Action

To identify the potential socioeconomic effects associated with construction and operation activities for the Proposed Action, estimated program-related employment and population information was obtained. The analysis included direct jobs (i.e., work directly for associated EELV activities) and indirect jobs (i.e., jobs created by goods and services purchased in the local communities). The direct and indirect job estimates and associated population numbers were calculated in conformance with established economic estimating guidelines for such analysis (U.S. Bureau of Economic Analysis, 1997c). Initial changes in economic activity in each region were used as inputs to a socioeconomic modeling system that utilizes the Regional Input-Output Modeling System (RIMS II) to provide estimates of total employment. All years referred to in this section are federal fiscal years (October through September), unless otherwise indicated.

4.2.1.1 Concept A

4.2.1.1.1 Concept A, Cape Canaveral AS

Employment. The number of direct and indirect jobs associated with launch activities at Cape Canaveral AS is anticipated to increase by up to 251 jobs during construction of EELV facilities between 1998 and 2000. Employment would decline from 1,210 under the Atlas IIA, Delta II, and Titan IVB launch programs to 240 when the EELV program is fully staffed in 2007 (Table 4.2-1). Although full staffing for Concept A launch activities would occur in 2003 at Cape Canaveral AS, for consistency within this EIS, the year 2007 has been selected for analysis purposes.

Table 4.2-1. Jobs and Worker Migration - Concept A, Cape Canaveral AS

	1997	1998	2000	2007
Total Jobs[(a)]	2,306	2,557	1,597	457
Direct	1,210	1,362	855	240
Construction	0	152	130	0
Operation	1,210	1,210	725	240
Current Operation	1,210	1,210	605	0
EELV Operation	0	0	120	240
Indirect	1,096	1,195	742	217
Construction-related	0	99	85	0
Operation-related	1,096	1,096	657	217
Current Operation-related	1,096	1,096	548	0
EELV Operation-related	0	0	109	217
Net Change in Total Jobs	0	251	-709	-1,849

Note: (a) Includes full- and part-time jobs.
EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

The number of indirect jobs associated with government launches supported within Brevard County would be reduced from its 1997 level of 1,096 to 217 by 2007.

By 2007, there would be a net decline of 970 direct and 879 indirect jobs within Brevard County, associated with the replacement of Atlas IIA, Delta II, and Titan IVB launch operations; however, employment in Brevard County is forecasted to increase from 231,553 in 1997 to 285,540 in 2007 (see Table 3.2-1). It was assumed that only 10 percent of the current launch program employees would leave Brevard County. Some of the workers approaching retirement age might decide to retire, but most of these workers would likely search for another job. The remaining 1,741 employees would be assumed to be transferred to EELV program operations, transferred by their employer to another business location, or seek other employment.

Population. The total number of persons associated with launch activities at Cape Canaveral AS (including all direct and indirect workers, plus members of their households) is anticipated to increase from its 1997 level of 6,227 to 6,904 during construction of EELV facilities, and then decline to a level of 1,235 when the EELV program is fully staffed in 2007 (Table 4.2-2). The population attributable to direct operation jobs would be reduced from 3,267 under the existing launch programs to 648 under the EELV program at full

Table 4.2-2. Total Population by Type of Job - Concept A, Cape Canaveral AS

	1997	1998	2000	2007
Total Persons, by type of job[(a)]	6,227	6,904	4,312	1,235
Direct	3,267	3,677	2,309	648
Construction	0	410	351	0
Operation	3,267	3,267	1,958	648
Current Operation	3,267	3,267	1,634	587
EELV Operation	0	0	324	0
Indirect	2,960	3,228	2,003	587
Construction-related	0	268	230	0
Operation-related	2,960	2,960	1,773	587
Current Operation-related	2,960	2,960	1,480	0
EELV Operation-related	0	0	294	587

Note: (a) Total population includes all workers holding direct or indirect jobs, plus their household members (assuming an average household size of 2.7 persons).

EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

employment; however, population in Brevard County is forecasted to increase from 460,824 in 1997 to 557,856 in 2007 (see Table 3.2-2).

The population attributable to indirect jobs resulting from launch programs within Brevard County would be reduced from its 1997 level of 2,960 to 587 by 2007. A temporary increase of 678 people in 1998 would be attributable to direct and indirect workers during the construction of EELV facilities.

The majority of the population attributable to EELV government activities would reside within the unincorporated area of Brevard County (with most of the direct population in unincorporated communities near Cape Canaveral AS), and in the cities of Cape Canaveral, Cocoa, Cocoa Beach, and Rockledge, which are all within 14 miles of Cape Canaveral AS. Much of the population effect in other cities, including Titusville (21 miles from Cape Canaveral AS), and Melbourne and Palm Bay (both 35 miles away), would be attributable to indirect workers. Some workers, both direct and indirect, would locate their households outside of Brevard County, principally in communities in Orange County, approximately 25 miles west of Cape Canaveral AS.

By 2007, there would be a net decline in population of 2,619 persons from direct jobs and 2,373 from indirect jobs within Brevard County. Incorporated cities within the ROI would lose the majority of residents leaving the county. It is assumed that only 10 percent of residents from the current launch operations would leave the ROI.

4.2.1.1.2 Concept A, Vandenberg AFB

Employment. The number of direct and indirect jobs associated with launch activities at Vandenberg AFB is anticipated to increase slightly during construction of EELV facilities from 1,500 to 2,128 in 2000. Employment would decline thereafter as the requirement for direct operation workers is reduced from 646 under the existing launch systems to 135 in 2007 (Table 4.2-3); however, employment in Santa Barbara County is forecasted to increase from 229,107 in 1997 to 271,380 in 2007 (see Table 3.2-3). Although full staffing for Concept A launch activities would occur in 2006 at Vandenberg AFB, for consistency within this EIS, the year 2007 has been selected for analysis purposes.

The number of indirect jobs within Santa Barbara County would be reduced from its 1997 level of 854 to 179 by 2007. The number of indirect jobs would increase slightly in 2000 during construction of EELV facilities (see Table 4.2-3).

Table 4.2-3. Jobs and Worker Migration - Concept A, Vandenberg AFB

	1997	1998	2000	2007
Total Jobs[a]	1,500	1,500	2,128	314
Direct	646	646	964	135
Construction	0	0	318	0
Operation	646	646	646	135
Current Operation	646	646	646	0
EELV Operation	0	0	0	135
Indirect	854	854	1,164	179
Construction-related	0	0	310	0
Operation-related	854	854	854	179
Current Operation-related	854	854	854	0
EELV Operation-related	0	0	0	179
Net Change in Total Jobs	0	0	628	-1,187

Note: (a) Includes full- and part-time jobs.
EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

By 2007, there would be a net decline of 1,187 direct and indirect jobs within Santa Barbara County. Only 10 percent of unemployed workers would leave the county. As discussed in Section 4.2.1.1.1, some workers would retire; others would search for another job.

Population. The total number of persons associated with launch activities at Vandenberg AFB (including all direct and indirect workers, plus members of their households) is anticipated to increase from a 1997 level of 4,051 to 5,746 during construction of EELV facilities, and decline to a level of 847 by 2007 (Table 4.2-4). The population attributable to direct operation jobs

Table 4.2-4. Total Population by Type of Job - Concept A, Vandenberg AFB

	1997	1998	2000	2007
Total Persons, by type of job[a]	4,051	4,051	5,746	847
Direct	1,744	1,744	2,603	365
Construction	0	0	859	0
Operation	1,744	1,744	1,744	365
Current Operation	1,744	1,744	1,744	0
EELV Operation	0	0	0	365
Indirect	2,307	2,307	3,143	482
Construction-related	0	0	836	0
Operation-related	2,307	2,307	2,307	482
Current Operation-related	2,307	2,307	2,307	0
EELV Operation-related	0	0	0	482

Note: (a) Total population includes all workers holding direct or indirect jobs, plus their household members (assuming an average household size of 2.7 persons).

EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

would be reduced from 1,744 under the existing launch programs to 365 under the EELV program; however, population in Santa Barbara County is forecasted to increase from 399,988 in 1997 to 445,415 in 2007 (see Table 3.2-4).

The population attributable to indirect jobs within Santa Barbara County would be reduced from its 1997 level of 2,307 to 482 by 2007. A small increase in the population attributable to indirect workers would occur during construction in 2000.

The majority of the population attributable to the EELV program would reside within the unincorporated area of Santa Barbara County (with most of the direct population located in unincorporated communities near Vandenberg AFB), and in the cities of Santa Maria and Lompoc, both of which are within 18 miles of Vandenberg AFB. Much of the population effect in other cities, including Santa Barbara (64 miles from Vandenberg AFB) and Carpinteria (76 miles), would be attributable to indirect workers. Some workers, both direct and indirect, would locate their households outside of Santa Barbara County, principally in communities in San Luis Obispo County, approximately 25 miles north of Vandenberg AFB.

4.2.1.2 Concept B

4.2.1.2.1 Concept B, Cape Canaveral AS

Employment. The number of direct and indirect jobs associated with launch activities at Cape Canaveral AS is anticipated to increase by up to 328 jobs during construction of EELV facilities in 2000. Employment would decline thereafter as the requirement for direct operation workers is reduced from 1,210 under the existing launch programs to 540 when the EELV program is fully staffed in 2007 (Table 4.2-5).

Table 4.2-5. Jobs and Worker Migration - Concept B, Cape Canaveral AS

	1997	1998	2000	2007
Total Jobs[(a)]	2,306	2,518	2,260	1,029
Direct	1,210	1,338	1,208	540
Construction	0	128	220	0
Operation	1,210	1,210	1,043	540
Current Operation	1,210	1,210	908	0
EELV Operation	0	0	135	540
Indirect	1,096	1,180	1,052	489
Construction-related	0	84	108	0
Operation-related	1,096	1,096	944	489
Current Operation-related	1,096	1,096	822	0
EELV Operation-related	0	0	122	489
Net Change in Total Jobs	0	212	-46	-1,277

Notes: (a) Includes full- and part-time jobs.

EELV = Evolved Expendable Launch Vehicle

Source: Estimates prepared for this study.

The number of indirect jobs supported within Brevard County would be reduced from its 1997 level of 1,096 to 489 by 2007; however, employment in Brevard County is forecasted to increase from 231,553 in 1997 to 285,400 in 2007 (see Table 3.2-1).

By 2007, there would be a net decline of 670 direct and 607 indirect jobs within Brevard County. With implementation of the EELV program and the associated reduction of 1,277 jobs, it was assumed that only 10 percent of the current residents would leave Brevard County. As discussed in Section 4.2.1.1, some workers would retire; others would search for another job. It was assumed that a small percentage of current residents would leave the county to search for other job opportunities or to retire. Most of the 1,247 persons who would change jobs would be transferred to support EELV program operations, transferred by their employer to another business location, or seek other employment.

Population. The total number of persons associated with launch activities at Cape Canaveral AS (including all direct and indirect workers, plus members of their households) is anticipated to increase from its 1997 level of 6,227 to 6,800 during construction of EELV facilities, and decline to a level of 2,779 persons by 2007 (Table 4.2-6). The population attributable to direct operation jobs would be reduced from 3,267 under the existing launch programs to 1,458 under the EELV program.

Table 4.2-6. Total Population by Type of Job - Concept B, Cape Canaveral AS

	1997	1998	2000	2007
Total Persons, by type of job[a]	6,227	6,800	6,102	2,779
Direct	3,267	3,614	3,260	1,458
Construction	0	347	446	0
Operation	3,267	3,267	2,815	1,458
Current Operation	3,267	3,267	2,450	0
EELV Operation	0	0	365	1,458
Indirect	2,960	3,186	2,841	1,321
Construction-related	0	227	292	0
Operation-related	2,960	2,960	2,550	1,321
Current Operation-related	2,960	2,960	2,550	0
EELV Operation-related	0	0	330	1,321

Note: (a) Total population includes all workers holding direct or indirect jobs, plus their household members (assuming an average household size of 2.7 persons).

EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

The population attributable to indirect jobs within Brevard County would be reduced from its current level of 2,960 to 1,321 by 2007. A small increase in the population of 292 attributable to indirect workers would occur in the year 2000 during construction of EELV facilities.

The majority of the population associated with Concept B would reside within the unincorporated area of Brevard County (see Section 4.2.1.1.1).

By 2007, there would be a net decline in population of 3,448 persons within Brevard County; however, population in Brevard County is forecasted to increase from 460,824 in 1997 to 557,856 in 2007 (see Table 3.2-2).

4.2.1.2.2 Concept B, Vandenberg AFB

Employment. The number of direct and indirect jobs associated with launch activities at Vandenberg AFB is anticipated to increase slightly during construction of EELV facilities in 1998 through 2000 from 1,500 to 1,714. Employment would decline thereafter as the requirement for direct operation workers is reduced from 646 under the existing launch programs to 400 in 2007 (Table 4.2-7).

The number of indirect jobs supported within Santa Barbara County would be reduced from its 1997 level of 854 to 529 by 2007.

During construction of EELV facilities in 2000, there would be a net increase of up to 108 direct and 105 indirect jobs within Santa Barbara County. By 2007, there would be a net decline of 571 direct and indirect jobs within Santa Barbara County; however, employment in Santa Barbara County is

Table 4.2-7. Jobs and Worker Migration - Concept B, Vandenberg AFB

	1997	1998	2000	2007
Total Jobs[(a)]	1,500	1,625	1,714	929
Direct	646	709	754	400
Construction	0	63	108	0
Operation	646	646	646	400
Current Operation	646	646	646	0
EELV Operation	0	0	0	400
Indirect	854	916	960	529
Construction-related	0	61	105	0
Operation-related	854	854	854	529
Current Operation-related	854	854	854	0
EELV Operation-related	0	0	0	529
Net Change in Total Jobs	0	124	213	-571

Note: (a) Includes full- and part-time jobs.

EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

forecasted to increase from 229,107 in 1997 to 271,380 in 2007 (see Table 3.2-3).

By 2007, 571 current Santa Barbara County residents would lose direct or indirect jobs associated with current launch operations, but most of them would remain in the county. It was assumed that only 10 percent would leave the county in search of other job opportunities, to retire, or would be transferred by their current employer.

Population. The total number of persons associated with government launch activities at Vandenberg AFB (including all direct and indirect workers, plus members of their households) is anticipated to increase from its current level of 4,051 to 4,626 by the year 2000 during construction of EELV facilities, and then decline to a level of 2,508 persons by 2007. The population attributable to direct operation jobs would be reduced from 1,744 under the current launch programs to 1,080 under the EELV program (Table 4.2-8).

The population attributable to indirect jobs within Santa Barbara County would be reduced from its 1997 level of 2,307 to 1,428 by 2007. A small increase in the population attributable to indirect workers would occur during construction of the EELV facilities.

The majority of the population attributable to Concept B would reside within the unincorporated area of Santa Barbara County (see Section 4.2.1.2.1).

By 2007, there would be a net decline in population of 1,543 persons within Santa Barbara County; however, the county population is forecasted to increase from 399,988 in 1997 to 445,415 in 2007 (see Table 3.2-4). With implementation of the EELV program and the associated reduction of 1,543

Table 4.2-8. Total Population by Type of Job - Concept B, Vandenberg AFB

	1997	1998	2000	2007
Total Persons, by type of job[(a)]	4,051	4,387	4,626	2,508
Direct	1,744	1,914	2,036	1,080
Construction	0	170	292	0
Operation	1,744	1,744	1,744	1,080
Current Operation	1,744	1,744	1,744	0
EELV Operation	0	0	0	1,080
Indirect	2,307	2,472	2,591	1,428
Construction-related	0	166	284	0
Operation-related	2,307	2,307	2,307	1,428
Current Operation-related	2,307	2,307	2,307	0
EELV Operation-related	0	0	0	1,428

Note: (a) Total population includes all workers holding direct or indirect jobs, plus their household members (assuming an average household size of 2.7 persons).

EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

residents, only 11 percent of the residents would be assumed to leave the ROI. The incorporated cities within the ROI would lose the majority of residents assumed to leave the county.

4.2.1.3 Concept A/B

4.2.1.3.1 Concept A/B, Cape Canaveral AS

Employment. The number of direct and indirect jobs associated with launch activities at Cape Canaveral AS is anticipated to increase slightly during construction of EELV facilities between 1998 and 2000. Employment would decline thereafter as the requirement for direct operation workers is reduced from 1,210 under the Atlas IIA, Delta II, and Titan IVB launch programs to 590 in 2007 at full employment (Table 4.2-9).

The number of indirect jobs associated with launches supported within Brevard County would be reduced from its 1997 level of 1,096 to 534 in 2007 at full employment; however, employment in the county is forecasted to increase from 231,553 in 1997 to 285,540 in 2007 (see Table 3.2-1). A small increase in the number of indirect jobs would occur in 2000 during construction of EELV facilities.

Additionally, there would be a net increase of up to 295 direct and 193 indirect jobs within Brevard County. At full employment in 2007, there would be a net decline of 1,182 jobs.

Population. The total number of persons associated with launch activities at Cape Canaveral AS (including all direct and indirect workers, plus members of their households) is anticipated to increase from its 1997 level of 6,227 to

Table 4.2-9. Jobs and Worker Migration - Concept A/B, Cape Canaveral AS

	1997	1998	2000	2007
Total Jobs[(a)]	2,306	2,769	2,499	1,124
Direct	1,210	1,490	1,350	590
Construction	0	280	295	0
Operation	1,210	1,210	1,055	590
Current Operation	1,210	1,210	908	0
EELV Operation	0	0	148	590
Indirect	1,096	1,279	1,149	534
Construction-related	0	183	193	0
Operation-related	1,096	1,096	956	534
Current Operation-related	1,096	1,096	822	0
EELV Operation-related	0	0	134	534
Net Change in Total Jobs	0	463	193	-1,182

Note: (a) Includes full- and part-time jobs.
EELV = Evolved Expendable Launch Vehicle
Sources: Estimates prepared for this study.

7,477 during construction of EELV facilities, and then decline to a level of 3,036 at full employment in 2007; however, the Brevard County population is forecasted to increase from 460,824 in 1997 to 557,856 in 2007 (see Table 3.2-2). The population attributable to direct operation jobs would be reduced from 3,267 under the current launch programs to 1,593 by 2007 (Table 4.2-10).

Table 4.2-10. Total Population by Type of Job - Concept A/B, Cape Canaveral AS

	1997	1998	2000	2007
Total Persons, by type of job[(a)]	6,227	7,477	6,747	3,036
Direct	3,267	4,023	3,645	1,593
Construction	0	756	797	0
Operation	3,267	3,267	2,849	1,593
Current Operation	3,267	3,267	2,450	0
EELV Operation	0	0	398	1,593
Indirect	2,960	3,454	3,102	1,443
Construction-related	0	495	521	0
Operation-related	2,960	2,960	2,580	1,443
Current Operation-related	2,960	2,960	2,220	0
EELV Operation-related	0	0	361	1,443

Note: (a) Total population includes all workers holding direct or indirect jobs, plus their household members (assuming an average household size of 2.7 persons).
EELV = Evolved Expendable Launch Vehicle
Sources: Estimates prepared for this study.

The majority of the population attributable to Concept A/B would reside within the unincorporated area of Brevard County (see Section 4.2.1.1.1).

By 2007, there would be a net decline in population of 3,191 persons with implementation of the EELV program. There would be an increase of 1,250 persons during construction activities. The incorporated cities within the ROI would lose the majority of the 10 percent of workers that are assumed to leave the ROI.

4.2.1.3.2 Concept A/B, Vandenberg AFB

Employment. The number of direct and indirect jobs associated with launch activities at Vandenberg AFB is anticipated to increase slightly during construction activities associated with the EELV program from 1998 until 2002. Employment would decline thereafter as the requirement for direct operation workers is reduced from 646 to 415 at full EELV employment in 2007 (Table 4.2-11).

Table 4.2-11. Jobs and Worker Migration - Concept A/B, Vandenberg AFB

	1997	1998	2000	2007
Total Jobs[(a)]	1,500	1,625	2,341	964
Direct	646	709	1,072	415
Construction	0	63	426	0
Operation	646	646	646	415
Current Operation	646	646	646	0
EELV Operation	0	0	0	415
Indirect	854	916	1,269	549
Construction-related	0	61	415	0
Operation-related	854	854	854	549
Current Operation-related	854	854	854	0
EELV Operation-related	0	0	0	549
Net Change in Total Jobs	0	124	841	-536

Note: (a) Includes full- and part-time jobs.
EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

The number of indirect jobs within Santa Barbara County would be reduced from its 1997 level of 854 to 549 by 2007. A small increase of 415 indirect jobs would occur in 2000 during construction of EELV facilities.

During construction of EELV facilities, there would be a total net increase of 841 jobs within Santa Barbara County. By 2007, there would be a net decline of 536 direct and indirect jobs; however, employment in Santa Barbara County is forecasted to increase from 229,107 in 1997 to 271,380 in 2007 (see Table 3.2-3).

By 2007, 536 residents would lose direct and indirect jobs associated with current launch programs. It was assumed that only 10 percent of current residents would leave the county.

Population. The total number of persons associated with Vandenberg AFB launch activities (including all direct and indirect workers, plus members of their households) is anticipated to increase from a 1997 level of 4,051 to 6,322 by 2000 during the construction of EELV facilities. The population would decline thereafter to a level of 2,602 by 2007 (Table 4.2-12). The population attributable to direct operation jobs would be reduced from 1,744 under the current launch programs to 1,212 during peak EELV launch operations in 2007.

Table 4.2-12. Total Population by Type of Job - Concept A/B, Vandenberg AFB

	1997	1998	2000	2007
Total Persons, by type of job[a]	4,051	4,387	6,322	2,602
Direct	1,744	1,914	2,895	1,212
Construction	0	170	1,150	0
Operation	1,744	1,744	1,744	1,121
Current Operation	1,744	1,744	1,744	0
EELV Operation	0	0	0	1,121
Indirect	2,307	2,472	3,427	1,482
Construction-related	0	166	1,120	0
Operation-related	2,307	2,307	2,307	1,482
Current Operation-related	2,307	2,307	2,307	0
EELV Operation-related	0	0	0	1,482

Note: (a) Total population includes all workers holding direct or indirect jobs, plus their household members (assuming an average household size of 2.7 persons).

EELV = Evolved Expendable Launch Vehicle

Sources: Estimates prepared for this study.

The population attributable to indirect jobs within Santa Barbara County would be reduced from its 1997 level of 2,307 to 1,482 by 2007; however, the Santa Barbara County population is forecasted to increase from 399,988 in 1997 to 445,415 in 2007 (see Table 3.2-4). A small increase in the population attributable to indirect workers would occur during construction of the EELV facilities.

The majority of the population attributable to the EELV program would reside within the unincorporated area of Santa Barbara County (see Section 4.2.1.2.1).

4.2.2 No-Action Alternative

4.2.2.1 Cape Canaveral AS

Employment. Under the No-Action Alternative, the number of direct jobs associated with launch activities at Cape Canaveral AS is anticipated to remain at its 1997 level of 1,210 through 2007 with continuation of the Atlas IIA, Delta II, and Titan IVB launch systems. The number of indirect jobs associated with current launch programs within Brevard County would remain at its 1997 level of 1,096 through 2007. Total employment in Brevard County is forecasted to increase from 231,553 to 285,540 between 1997 and 2007.

Population. The total number of persons associated with launch activities at Cape Canaveral AS (including all direct and indirect workers, plus members of their households) is anticipated to remain at its 1997 level of 6,227 through 2007 under the No-Action Alternative. The population attributable to direct and indirect jobs associated with current launch programs would remain at its 1997 level of 3,267 and 2,960, respectively. The Brevard County population is forecasted to increase from 460,824 to 557,856 between 1997 and 2007.

The majority of the population attributable to the existing launch programs resides within the unincorporated area of Brevard County (with most of the direct population in unincorporated communities near Cape Canaveral AS), and in the cities of Cape Canaveral, Cocoa, Cocoa Beach, and Rockledge. Much of the population effect in other cities, including Titusville, Melbourne, and Palm Bay, is attributable to indirect workers. Some workers, both direct and indirect, locate their households outside of Brevard County, principally in communities in Orange County.

4.2.2.2 Vandenberg AFB

Employment. Under the No-Action Alternative, the number of direct jobs associated with government launch activities at Vandenberg AFB is anticipated to remain at its 1997 level of 646 through 2007 with continuation of the Atlas IIA, Delta II, and Titan IVB launch systems. The number of indirect jobs associated with current launch programs within Santa Barbara County would remain at its current level of 854 through 2007 under the No-Action Alternative. Total employment in Santa Barbara County is forecasted to increase from 229,107 to 271,380 between 1997 and 2007.

Population. The total number of persons associated with launch activities at Vandenberg AFB (including all direct and indirect workers, plus members of their households) is anticipated to remain at its 1997 level of 4,051 through 2007 under the No-Action Alternative. The population attributable to direct and indirect jobs associated with current launch programs would remain at its 1997 level of 1,744 and 2,307, respectively. The Santa Barbara County population is forecasted to increase from 399,988 to 445,415 between 1997 and 2007.

The majority of the population attributable to the current launch programs resides within the unincorporated area of Santa Barbara County (with most of the direct population in unincorporated communities near Vandenberg AFB), and in the cities of Santa Maria and Lompoc. Much of the population effect in other cities, including Santa Barbara and Carpinteria, is attributable to indirect workers. Some workers, both direct and indirect, locate their households outside of Santa Barbara County, principally in communities in San Luis Obispo County.

4.3 LAND USE AND AESTHETICS

4.3.1 Proposed Action

4.3.1.1 Concept A

4.3.1.1.1 Concept A, Cape Canaveral AS

Regional Land Use. Concept A activities would be compatible with existing and planned land uses in the ROI; therefore, incompatible land uses would not result.

Cape Canaveral AS Land Use. Construction and operation activities associated with Concept A would occur primarily at SLC-41, an area that is currently designated for space launch activities. Proposed EELV uses would be consistent with the Base Comprehensive Plan and the mission of the Air Force at Cape Canaveral AS as "the best source of development space for new launch facilities is the old pads, remediated and rebuilt" (45 Space Wing, 1995c). The proposed EELV launch program would not result in conversion of prime agricultural land or cause a decrease in the utilization of land.

Coastal Zone Management. SLC-41 does not lie within the FCMA no-development zone, so construction and modification of facilities is consistent with the FCMA. Additionally, the contractor would coordinate with 45 SW Civil Engineering prior to design of EELV facilities to ensure adherence to all siting standards. However, SLC-41 does lie within the coastal zone and is subject to a federal coastal zone consistency determination as outlined in the FCMA, which is administered by the FDCA. The effects of the EELV program on the coastal zone will be evaluated. The Air Force will prepare a Coastal Zone Consistency Determination for the EELV program and submit it to the FDCA for review.

Recreation. EELV launches would not result in a loss of public recreation activities in the area because there are no public beaches in the launch area on Cape Canaveral AS. Neither public beaches nor other public facilities would be closed as a result of launch activities; however, recreational fishing activities available to KSC and Cape Canaveral AS personnel may be restricted during a launch. This restriction would be temporary and is not considered an adverse impact because limitations due to launch activities are routine at the installation.

Aesthetics. Views of Cape Canaveral AS from public beaches, marine vessels, and surrounding communities would be altered slightly by new construction at SLC-41. However, views of Cape Canaveral AS are primarily limited to marine traffic on the east and west and distant off-site beach areas and small communities to the south. Although EELV operations at SLC-41 would modification and demolition of existing structures, abandonment of buildings, and construction of new facilities, the aesthetic view of the site, an existing launch facility, would not change noticeably as a result of these activities. In addition, all views are distant views. Therefore, construction and operations under Concept A would not affect the area's aesthetic quality nor would they obscure any scenic views.

No adverse land use impacts are anticipated from Concept A EELV activities at Cape Canaveral AS; therefore, no mitigation measures would be required.

4.3.1.1.2 Concept A, Vandenberg AFB

Regional Land Use. Concept A activities would be compatible with existing and planned land uses in the ROI; therefore, incompatible land uses would not result.

Vandenberg AFB Land Use. Construction and operations associated with Concept A would occur primarily at SLC-3W, an area currently designated for space launch activities. Proposed EELV uses would be consistent with the Base Comprehensive Plan and the Air Force mission at Vandenberg AFB. The proposed EELV activities would not result in conversion of prime agricultural land or cause a decrease in land utilization.

Coastal Zone Management. As defined in the Coastal Zone Management Plan (CZMP), federal activities in, or affecting, a coastal zone must be consistent with the CZMP. Since the EELV program would result in public beach closures, a coastal zone consistency determination is required to support EELV program activities. The California Coastal Commission administers the CZMP. The effects of the EELV program on the coastal zone will be evaluated, and the Air Force will prepare a Coastal Zone Consistency Determination for the EELV program and submit it to the California Coastal Commission for review.

Recreation. Under Concept A, Jalama Beach and Ocean Beach county parks would be closed for all launches from SLC-3W. A maximum of 10 launches would occur during the peak year (2007). The parks would be closed for up to 8 hours per launch event. No mitigation measures are available to reduce this impact; however, beach closures during launch activities are routine at the installation.

Aesthetics. Views of Vandenberg AFB from public beaches, marine vessels, and railroad tracks would be slightly altered by Concept A construction activities. The nearest public views are those seen by passengers aboard the Southern Pacific Railroad line that runs through the base. Views of South Vandenberg AFB are limited by topography. Although EELV operations at SLC-3W would require modification and demolition of existing structures, abandonment of buildings, and construction of new facilities, the aesthetic view of the site, an existing launch facility, would not change noticeably as a result of these activities. In addition, most public views are distant views. Therefore, construction and operations under Concept A would not alter the aesthetic quality of the area nor would they obscure any scenic views. Prior to design of EELV facilities, the contractor would coordinate with 30 SW Civil Engineering to ensure adherence to facility design standards.

Other than beach closures, no land use impacts are anticipated; therefore, no mitigation measures are required.

4.3.1.2 Concept B

4.3.1.2.1 Concept B, Cape Canaveral AS

Regional Land Use. As discussed in Section 4.3.1.1.1, under Regional Land Use, the EELV program would be compatible with existing and planned land uses in the ROI; therefore, incompatible land uses would not result.

Cape Canaveral AS Land Use. Construction and operation activities associated with Concept B would occur primarily at SLC-37, an area currently designated for space launch activities. As discussed in Section 4.3.1.1.1, under Cape Canaveral AS Land Use, no impacts to land use on Cape Canaveral AS are expected from EELV activities.

Coastal Zone Management. SLC-37 does not lie within the no-development zone, so construction and modification of facilities is consistent with the FCMA. Additionally, the contractor would coordinate with 45 SW Civil Engineering prior to design of EELV facilities to ensure adherence to all siting standards. As discussed in Section 4.3.1.1.1, under Coastal Zone Management, a Coastal Zone Consistency Determination for EELV program activities will be prepared.

Recreation. Recreation impacts resulting from Concept B implementation at SLC-37 would be similar to those described in Section 4.3.1.1.1, under Recreation.

Aesthetics. Aesthetic impacts at SLC-37 resulting from Concept B would be similar to those described under Section 4.3.1.1.1, under Aesthetics.

No adverse land use impacts are anticipated from EELV activities; therefore, no mitigation measures would be required.

4.3.1.2.2 Concept B, Vandenberg AFB

Regional Land Use. As discussed in Section 4.3.1.1.2, under Regional Land Use, the EELV program would be compatible with existing and planned land uses in the ROI; therefore, incompatible land uses would not result.

Vandenberg AFB Land Use. Construction and operation activities associated with Concept B would occur primarily at SLC-6, an area currently designated for space launch activities. As discussed in Section 4.3.1.1.2, under Vandenberg AFB Land Use, no impacts to land use on Vandenberg AFB are expected from EELV activities.

Coastal Zone Management. As discussed under Section 4.3.1.1.2, under Coastal Zone Management, a coastal zone consistency determination for EELV activities will be prepared.

Recreation. Under Concept B, Ocean Beach County Park would not be closed during SLC-6 launches. Jalama Beach County Park would be closed for launches with azimuths of between 140 and 180 degrees. Assuming that all launches during the peak year (2007) would utilize this range of azimuths, a maximum of 10 closures of Jalama Beach County Park would be required.

The park would be closed for up to 8 hours per launch event. No mitigation measures are available to reduce this impact.

Aesthetics. Aesthetic impacts at SLC-6 resulting from Concept B would be similar to those described under Section 4.3.1.1.2, under Aesthetics.

Other than beach closures, no land use impacts are anticipated; therefore, no mitigation measures would be required.

4.3.1.3 Concept A/B

4.3.1.3.1 Concept A/B, Cape Canaveral AS

Regional Land Use. As discussed in Sections 4.3.1.1.1 and 4.3.1.2.1, under Regional Land Use, the EELV program would be compatible with existing and planned land uses in the ROI; therefore, incompatible land uses would not result.

Cape Canaveral AS Land Use. Construction and operation activities associated with Concept A/B would occur primarily at SLC-41 and SLC-37, areas currently designated for space launch activities. As discussed in Sections 4.3.1.1.1 and 4.3.1.2.1, under Cape Canaveral AS Land Use, no impacts to land use on Cape Canaveral AS are expected from EELV activities.

Coastal Zone Management. A federal coastal zone consistency determination as discussed in Sections 4.3.1.1.1 and 4.3.1.2.1, under Coastal Zone Management, would be required for Concept A/B activities.

Recreation. Recreation impacts resulting from implementation of Concept A/B at SLC-41 and SLC-37 would be similar to those described under Concepts A and B, Sections 4.3.1.1.1 and 4.3.1.2.1, under Recreation.

Aesthetics. Aesthetic impacts at SLC-41 and SLC-37 resulting from Concept A/B would be similar to those described under Sections 4.3.1.1.1 and 4.3.1.2.1, under Aesthetics.

No adverse land use impacts are anticipated from EELV activities; therefore, no mitigation measures would be required.

4.3.1.3.2 Concept A/B, Vandenberg AFB

Regional Land Use. As discussed in Sections 4.3.1.1.2 and 4.3.1.2.2, under Regional Land Use, the EELV program would be compatible with existing and planned land uses in the ROI; therefore, incompatible land uses would not result.

Vandenberg AFB Land Use. Construction and operation activities associated with Concept A/B would occur primarily at SLC-3W and SLC-6, areas currently designated for space launch activities. As discussed in Sections 4.3.1.1.2 and 4.3.1.2.2, under Vandenberg AFB Land Use, no impacts to land use on Vandenberg AFB are expected from EELV activities.

Coastal Zone Management. As discussed in Sections 4.3.1.1.2 and 4.3.1.2.2, under Coastal Zone Management, a coastal zone consistency determination for EELV activities will be prepared.

Recreation. Under Concept A/B, Jalama Beach and Ocean Beach county parks would be closed for all launches from SLC-3W; a maximum of 7 launches is planned for the peak year (2007). As discussed in Section 4.3.1.2.2, launches from SLC-6 would require closure of Jalama Beach County Park, depending on the launch azimuth. A maximum of 7 launches would occur from SLC-6 during the peak year. The parks would be closed for up to 8 hours per launch event. No mitigation measures are available to reduce this impact.

Aesthetics. Aesthetic impacts at SLC-3W and SLC-6 resulting from Concept A/B would be similar to those described under Sections 4.3.1.1.2 and 4.3.1.2.2, under Aesthetics.

Other than unavoidable beach closures, no other land use impacts are anticipated; therefore, no mitigation measures would be required.

4.3.2 No-Action Alternative

4.3.2.1 Cape Canaveral AS. Under the No-Action Alternative, no changes in land use are proposed, and no construction or modification of facilities would occur; therefore, no impacts to land use and aesthetics are expected.

4.3.2.2 Vandenberg AFB. Under the No-Action Alternative, county beaches would continue to be closed for as many as six launches per year. No mitigation measures are available to reduce this impact. No other land use and aesthetics impacts are anticipated because no changes in land use and no construction or modification of facilities is proposed.

4.4 TRANSPORTATION

This section describes the effects on key roadways and railroads expected to be impacted by the Proposed Action and No-Action Alternative.

4.4.1 Proposed Action

The ADT generated by the EELV program proposed for Cape Canaveral AS and Vandenberg AFB is expected to be less than 50 percent of the ADT generated by the current launch activities that would be replaced by this project. As a result, traffic volumes generated under the Proposed Action on the key roadways used to support the EELV program should be less than those under the existing launch programs.

Roadways

The effects on roadway traffic were assessed by estimating the number of trips generated by employees, visitors, and service vehicles associated with construction and operations. These trips were distributed to the roadway system based on existing travel patterns. This analysis is based on existing data on roadway capacities, existing and projected traffic volumes and patterns, and standards established by state local transportation agencies.

Trip generation was estimated by applying the trip rates from the ITE Trip Generation Manual, 5th Edition, combined with other project trip generation data, to obtain daily traffic volumes. Peak-hour traffic volumes generated under the Proposed Action were distributed to the installation and local road networks using trip distribution patterns from current launch programs. To determine traffic effects from the Proposed Action on local roadways, traffic volumes from each EELV concept were compared to the baseline year (1996).

Railways

Railroad lines in the Cape Canaveral AS area fall outside the launch pad safety corridor for the station. The main line of the Southern Pacific Railroad passes through the launch pad safety corridor at Vandenberg AFB. An average of four passenger and eight freight trains pass through Vandenberg AFB each day. Launches from Vandenberg AFB are coordinated with the railroad. Therefore, no impacts to railroad systems are expected at either location.

4.4.1.1 Concept A. Direct and indirect traffic impacts were determined for key local roadways related to Concept A and are discussed in this section. Under Concept A, project-related traffic is expected to increase slightly during construction of EELV facilities between 1998 and 2000, but to decline during the operational phase as employment decreases.

4.4.1.1.1 Concept A, Cape Canaveral AS. At the peak period of the construction phase, peak-hour traffic generated by construction workers would add approximately 250 vehicles to Samuel C. Phillips Parkway/Hangar Road. Approximately 50 vehicles would exit Cape Canaveral AS to the west on the NASA Causeway, and the remaining 200 vehicles would continue south and exit Cape Canaveral AS at Gate 1. This construction traffic is likely to increase the peak-hour traffic to approximately 2,100 vehicles on Samuel C. Phillips Parkway/Hangar Road, which would continue to operate at LOS A (Table 4.4-1). Although the local road system would experience a temporary increase in traffic, the increase is not expected to change projected LOS on key local roads.

By 2015, EELV activities would be expected to generate approximately 150 trips during the evening peak hour on Samuel C. Phillips Parkway. Approximately 50 vehicles would exit Cape Canaveral AS to the west by way of the NASA Causeway, and the remaining 100 vehicles would continue south and exit Cape Canaveral AS at Gate 1 (see Table 4.4-1). The roadway would continue to operate at LOS A. No measurable changes in peak-hour traffic are expected on Samuel C. Phillips Parkway/Hangar Road north of the project area. The local road system would experience a reduction in traffic entering and exiting the station. The reductions are not expected to change projected LOS on key local roads. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

4.4.1.1.2 Concept A, Vandenberg AFB. At the peak period of the construction phase of the project, peak-hour traffic generated by construction workers would add approximately 350 vehicles to Coast and Bear Creek roads. This construction traffic is likely to increase the PHV on these roads from the project location to Ocean Avenue (Table 4.4-2). The LOS on Bear Creek Road would change from A to B. When distributed to the local road system, the construction-related traffic would increase the PHV exiting the base by approximately 200 vehicles at each exit location, Ocean Avenue and the Santa Maria Gate. This temporary increase in the peak-hour traffic due to construction activities would not have a long-range measurable effect on the projected LOS of any local road segments.

Table 4.4-1. Peak-Hour Volumes, Concept A
Cape Canaveral AS

Roadway	Segment/ No. of Lanes	Capacity (vehicles per hour)	1996[(a)] PHV	LOS	2000 PHV	2000 LOS	2015 PHV	2015 LOS
SR A1A	Samuel C. Phillips Parkway, south; 4-lane	8,000	3,950	C	4,300	C	5,300	C
SR A1A	Samuel C. Phillips Parkway, east; 4-lane	8,000	3,750	B	3,900	B	3,850	B
NASA Causeway	Between US 1 and Samuel C. Phillips Parkway; 4-lane	8,000	1,750	A	1,850	A	1,750	A
Samuel C. Phillips Parkway/Hangar Road	Between SR 401 (Gate 1) and SR 401 (Gate 6) on CCAS 4-lane	8,000	1,900	A	2,100	A	1,350	A

Note: (a) Peak-hour volume based on 10 percent of average daily traffic from Brevard County traffic counts.
CCAS = Cape Canaveral Air Station
LOS = level of service
NASA = National Aeronautics and Space Administration
PHV = peak-hour volume
SR = State Route

Source: Brevard County, undated

Table 4.4-2. Peak-Hour Volumes, Concept A Vandenberg AFB

Roadway	Segment/ No. of Lanes	Capacity (vehicles per hour)	1996[(a)] PHV	LOS	2000 PHV	2000 LOS	2015 PHV	2015 LOS
Coast Road	Between SLC-6 and Bear Creek Road; 2-lane	2,800	350	A	350	A	0	A
Bear Creek Road	Between Coast Road and Ocean Avenue; 2-lane	2,800	350	A	700	B	100	A
13th Street	Between Ocean Avenue and Santa Maria Gate; 2-lane	2,800	1,550	D	1,700	D	1,400	D
Ocean Avenue	Between Bear Creek Road and SR; 4-lane	8,000	250	A	400	A	100	A
SR 1	Between Santa Maria Gate and SR 135; 4-lane	8,000	1,550	B	1,700	B	1,400	B

Note: (a) Peak-hour volume based on 10 percent of average daily traffic from Santa Barbara County traffic counts.
LOS= level of service
PHV= peak-hour volume
SR = State Route

Source: Santa Barbara County Planning Department, 1996

By 2015, EELV program activities are expected to generate approximately 100 trips during the evening peak hour. Peak-hour traffic on Coast and Bear Creek roads is expected to decline. The LOS on these roads would remain the same or improve as a result of the reduced peak-hour traffic volume (see Table 4.4-2). Approximately 52 percent of the project-related traffic, or 50 vehicles, is expected to travel east on Ocean Avenue from Bear Creek Road toward Lompoc and SR 246. The remaining 50 vehicles would travel north on 13th Street, exiting the base at the Santa Maria Gate. As a result, it is estimated that approximately 250 fewer vehicles would enter the local road system at each of the base gates. Although the local road system would experience a reduction in traffic, the reductions are not expected to change projected LOS. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

4.4.1.2 Concept B. Direct and indirect traffic impacts were determined for key local roadways related to Concept B and are discussed in this section. Under Concept B, project-related traffic is expected to increase slightly during construction of EELV facilities between 1998 and 2000, but decline during the operational phase as employment decreases.

4.4.1.2.1 Concept B, Cape Canaveral AS. At the peak period of the construction phase of the project, peak-hour traffic generated by construction workers would add approximately 250 vehicles to Samuel C. Phillips Parkway/Hangar Road. Approximately 50 vehicles would exit Cape Canaveral AS to the west on the NASA Causeway, and the remaining 200 vehicles would continue south and exit Cape Canaveral AS at Gate 1 (Table 4.4-3). This construction traffic is likely to increase the PHV on Samuel C. Phillips Parkway/Hangar Road south of the project location to approximately 2,100 vehicles. Samuel C. Phillips Parkway/Hangar Road would continue to operate at LOS A. Although the local road system would experience an increase in traffic, the increase is not expected to change projected LOS on key local roads.

By 2015, EELV program activities are expected to generate approximately 350 trips during the evening peak hour on Samuel C. Phillips Parkway; the LOS would not be affected by the reduced traffic volume. Approximately 50 vehicles would exit Cape Canaveral AS to the west on the NASA Causeway, and the remaining 300 vehicles would continue south and exit Cape Canaveral AS at Gate 1 (see Table 4.4-3). No measurable changes in peak-hour traffic volume are expected on Samuel C. Phillips Parkway/Hangar Road north of the project area. The local road system would experience a reduction in traffic entering and exiting the station, but LOS on key local roads would not change. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

Table 4.4-3. Peak-Hour Volumes, Concept B
Cape Canaveral AS

Roadway	Segment/No. of Lanes	Capacity (vehicles per hour)	1996[a] PHV	2000 PHV	2000 LOS	2015 PHV	2015 LOS
SR A1A	Samuel C. Phillips Parkway, south; 4-lane	8,000	3,950	4,300	C	5,350	C
SR A1A	Samuel C. Phillips Parkway, east; 4-lane	8,000	3,750	3,900	B	3,950	B
Samuel C. Phillips Parkway/Hangar Road	Between SR 401 (Gate 1) and SR 401 (Gate 6) on CCAS 4-lane	8,000	1,900	2,100	A	1,500	A
NASA Causeway	Between US 1 and Samuel C. Phillips Parkway; 4-lane	8,000	1,750	1,850	A	1,800	A

Note: (a) Peak-hour volume based on 10 percent of average daily traffic from Brevard County traffic counts.
CCAS = Cape Canaveral Air Station
LOS = level of service
NASA = National Aeronautics and Space Administration
PHV = peak-hour volume
SR = State Route

Source: Brevard County, undated

4.4.1.2.2 Concept B, Vandenberg AFB. At the peak period of the construction phase of the project, peak-hour traffic generated by construction workers would add approximately 150 vehicles to Coast and Bear Creek roads. This construction traffic is likely to increase the PHV on these roads from the project location to Ocean Avenue (Table 4.4-4). The LOS on Bear Creek Road would change from A to B. When distributed to the local road system, the construction-related traffic would increase the PHV exiting the base by approximately 50 vehicles at each exit location, Ocean Avenue and the Santa Maria Gate. This increase in the peak-hour traffic would not have a permanent measurable effect on the projected LOS for any local road segments.

By 2015, EELV activities are expected to generate approximately 250 trips during the evening peak hour. Peak-hour traffic on Bear Creek Road is expected to decline, but the LOS would not change (see Table 4.4-4). Approximately 52 percent of the project-related traffic, or 150 vehicles, is expected to travel east on Ocean Avenue from Bear Creek Road towards Lompoc and SR 246. The remaining 100 vehicles would travel north on 13th Street, exiting the base at the Santa Maria Gate. As a result, it is estimated that approximately 150 fewer vehicles would enter the local road system at each of the base gates. Although the local road system would experience a reduction in traffic, the reductions are not expected to change projected LOS. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

Table 4.4-4. Peak-Hour Volumes, Concept B
Vandenberg AFB

Roadway	Segment/No. of Lanes	Capacity (vehicles per hour)	1996 PHV[(a)]	2000 PHV	2000 LOS	2015 PHV	2015 LOS
Coast Road	Between SLC-6 and Bear Creek Road; 2-lane	2,800	50	50	A	50	A
Bear Creek Road	Between Coast Road and Ocean Avenue; 2-lane	2,800	350	500	B	250	A
13th Street	Between Ocean Avenue and Santa Maria Gate; 2-lane	2,800	1,550	1,600	D	1,500	D
Ocean Avenue	Between Bear Creek Road and SR 1; 4-lane	8,000	250	300	A	200	A
SR 1	Between Santa Maria Gate and SR 135; 4-lane	8,000	1,550	1,600	B	1,500	B

Note: (a) Peak-hour volume based on 10 percent of average daily traffic from Santa Barbara County traffic counts.
LOS = level of service
PHV = peak-hour volume
SR = State Route

Source: Santa Barbara County Planning Department, 1996

4.4.1.3 Concept A/B. Direct and indirect traffic impacts were determined for key local roadways related to Concept A/B and are discussed in this section. Under Concept A/B, project-related traffic is expected to increase slightly during construction activities related to EELV and to decline during operations.

4.4.1.3.1 Concept A/B, Cape Canaveral AS. During construction, peak-hour traffic generated by construction workers would add approximately 500 vehicles to Samuel C. Phillips Parkway/Hangar Road. This construction traffic is likely to increase PHV on Samuel C. Phillips Parkway/Hangar Road south of the project location to approximately 2,300 vehicles. The LOS on Samuel C. Phillips Parkway/Hangar Road would remain at LOS A. Approximately 100 vehicles would exit Cape Canaveral AS to the west by way of the NASA Causeway, and the remaining 400 vehicles would continue south and exit Cape Canaveral AS at Gate 1 (Table 4.4-5). The construction-related traffic would create a temporary increase in the peak-hour traffic and the LOS on SR A1A east of the station would change from B to C.

By 2015, EELV program activities would be expected to generate approximately 400 trips during the peak evening hour. Peak-hour traffic on Samuel C. Phillips Parkway is expected to decline; however, the LOS would not be affected by the reduced traffic volume. Approximately 100 vehicles would exit Cape Canaveral AS to the west on the NASA Causeway, and the

Table 4.4-5. Peak-Hour Volumes, Concept A/B Cape Canaveral AS

Roadway	Segment/No. of Lanes	Capacity (vehicles per hour)	1996[(a)] PHV	2000 PHV	2000 LOS	2015 PHV	2015 LOS
SR A1A	Samuel C. Phillips Parkway, south; 4-lane	8,000	3,950	4,400	C	5,350	C
SR A1A	Samuel C. Phillips Parkway, east; 4-lane	8,000	3,750	4,050	C	4,000	B
Samuel C. Phillips Parkway/ Hangar Road	Between SR 401 (Gate 1) and SR 401 (Gate 6) on CCAS 4-lane	8,000	1,900	2,300	A	1,550	A
NASA Causeway	Between US 1 and Samuel C. Phillips Parkway; 4-lane	8,000	1,750	1,800	A	1,800	A

Note: (a) Peak-hour volume based on 10 percent of average daily traffic from Brevard County traffic counts.
CCAS = Cape Canaveral Air Station
LOS = level of service
NASA = National Aeronautics and Space Administration
PHV = peak-hour volume
SR = State Route

Source: Brevard County, undated

remaining 300 would continue south and exit Cape Canaveral AS at Gate 1 (see Table 4.4-5). No measurable changes in peak-hour traffic are expected on Samuel C. Phillips Parkway/Hangar Road north of the project area. Although the local road system would experience a reduction in traffic, the reductions are not expected to change projected LOS. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

4.4.1.3.2 Concept A/B, Vandenberg AFB. At the peak period of the construction phase of the project, peak-hour traffic generated by construction workers would add approximately 500 vehicles to Coast and Bear Creek roads. This construction traffic is likely to increase the PHV on these roads from the project location to Ocean Avenue (Table 4.4-6). The LOS on Bear Creek Road would change from A to C, and the LOS on 13th Street would change from D to E. When distributed to the local road system, the construction-related traffic would increase PHV exiting the base by approximately 250 vehicles at each exit location, Ocean Avenue and the Santa Maria Gate. During EELV construction activities, the LOS on Ocean Avenue would temporarily change.

By 2015, EELV program activities are expected to generate approximately 300 trips during the evening peak hour. Peak-hour traffic on Coast and Bear Creek roads is expected to decline. The LOS on Bear Creek Road would improve from LOS C to LOS A, and the LOS on 13th Street would improve

Table 4.4-6. Peak-Hour Volumes, Concept A/B Vandenberg AFB

Roadway	Segment/No. of Lanes	Capacity (vehicles per hour)	1996 PHV[(a)]	2000 PHV	2000 LOS	2015 PHV	2015 LOS
Coast Road	Between SLC-6 and Bear Creek Road; 2-lane	2,800	350	350	A	50	A
Bear Creek Road	Between Coast Road and Ocean Avenue; 2-lane	2,800	350	850	C	300	A
13th Street	Between Ocean Avenue and Santa Maria Gate; 2-lane	2,800	1,550	1,800	E	1,500	D
Ocean Avenue	Between Bear Creek Road and SR 1; 4-lane	8,000	250	500	B	200	A
SR 1	Between Santa Maria Gate and SR 135; 4-lane	8,000	1,550	1,800	B	1,500	B

Note: (a) Peak-hour traffic based on 10 percent of average daily traffic from Santa Barbara County traffic counts.
LOS = level of service
PHV= peak-hour volume
SR = State Route

Source: Santa Barbara County Planning Department, 1996

from LOS E to LOS D (see Table 4.4-6). Approximately 52 percent of the project-related traffic, or 150 vehicles, is expected to travel east on Ocean Avenue from Bear Creek Road toward Lompoc and SR 246. The remaining 150 vehicles would travel north on 13th Street, exiting the base at the Santa Maria Gate. As a result, it is estimated that approximately 150 fewer vehicles would enter the local road system at each of the exits as a result of Concept A/B implementation. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

4.4.2 No-Action Alternative

Direct and indirect traffic impacts determined for key local roadways related to the No-Action Alternative are discussed in this section. Project-related traffic would continue at existing volumes throughout the analysis period, and there would be no changes to the existing roadways within the ROI as a result of launch vehicle programs.

4.4.2.1 Cape Canaveral AS. Traffic volumes on key local roadways at Cape Canaveral AS under the No-Action Alternative would include the current traffic generated by existing launch operations. Existing launch operations are estimated to contribute approximately 800 vehicles to the peak-hour volume on Samuel C. Phillips Parkway/Hangar Road. Approximately 150 vehicles exit the station on the NASA Causeway, with the remaining vehicles using the southern gate at SR 401. The launch-related traffic comprises approximately 40 percent of the peak-hour traffic on Samuel C. Phillips Parkway/Hangar

Road, which is expected to continue to operate at LOS A under the No-Action Alternative (Table 4.4-7).

Table 4.4-7. Peak-Hour Volumes, No-Action Alternative Cape Canaveral AS

Roadway	Segment/No. of Lanes	Capacity (vehicles per hour)	1996[a] PHV	2000 PHV	2000 LOS	2015 PHV	2015 LOS
SR A1A	Samuel C. Phillips Parkway, south; 4-lane	8,000	3,950	4,200	C	5,500	C
SR A1A	Samuel C. Phillips Parkway, east; 4-lane	8,000	3,750	3,800	B	4,200	C
Samuel C. Phillips Parkway/ Hangar Road	Between SR 401 (Gate 1) and SR 401 (Gate 6) on CCAS 4-lane	8,000	1,900	1,900	A	1,900	A
NASA Causeway	Between US 1 and Samuel C. Phillips Parkway; 4-lane	8,000	1,750	1,800	A	1,900	A

Note: (a) Peak-hour volume based on 10 percent of average daily traffic from Brevard County traffic counts.
CCAS = Cape Canaveral Air Station
LOS = level of service
NASA = National Aeronautics and Space Administration
PHV = peak-hour volume
SR = State Route

Source: Brevard County, undated

4.4.2.2 Vandenberg AFB. Traffic volumes on key local roadways at Vandenberg AFB under the No-Action Alternative would include the current traffic generated by existing launch operations, which are estimated to contribute approximately 350 vehicles to the peak-hour volume on Coast and Bear Creek roads. Approximately 200 vehicles exit the base at Ocean Avenue, east toward Lompoc and SR 246. The remaining 150 vehicles travel north on 13th Street and exit the base at the Santa Maria Gate (Table 4.4-8).

4.5 UTILITIES

The utility systems addressed in this analysis include the facilities and infrastructure used for potable water supply, wastewater collection and treatment, solid waste disposal, and electricity. Direct and indirect changes in future utility consumption for the Proposed Action and the No-Action

Table 4.4-8. Peak-Hour Volumes, No-Action Alternative Vandenberg AFB

Roadway	Segment/No. of Lanes	Capacity (vehicles per hour)	1996 PHV[(a)]	2000 PHV	2000 LOS	2015 PHV	2015 LOS
Coast Road	Between SLC-6 and Bear Creek Road; 2-lane	2,800	350	350	A	350	A
Bear Creek Road	Between Coast Road and Ocean Avenue; 2-lane	2,800	350	350	A	350	A
13th Street	Between Ocean Avenue and Santa Maria Gate; 2-lane	2,800	1,550	1,550	D	1,750	D
Ocean Avenue	Between Bear Creek Road and SR 1; 4-lane	8,000	250	250	A	250	A
SR 1	Between Santa Maria Gate and SR 135; 4-lane	8,000	1,550	1,550	B	2,150	B

Note: (a) Peak-hour traffic based on 10 percent of average daily traffic from Santa Barbara County traffic counts.
LOS = level of service
PHV = peak-hour volume
SR = State Route

Source: Santa Barbara County Planning Department, 1996

Alternative were estimated based on project-related requirements and per capita average daily use within the applicable ROI.

4.5.1 Proposed Action

This section describes direct and indirect changes in utility consumption for the Proposed Action. Impacts for each utility system were determined for the average construction period and for peak launch periods. Under the Proposed Action, direct and indirect project-related employment and population are expected to decrease (see Section 4.2). As a result, demands on those utilities affected by changes in population and employment within each region would also decrease from the amounts expected to occur under the No-Action Alternative. Additional facilities required by the Proposed Action are expected to create minimal increases for some utilities. However, these project-related fluctuations in utility usage would be small in comparison to changes associated with projected growth within each region.

4.5.1.1 Concept A

4.5.1.1.1 Concept A, Cape Canaveral AS

Water Supply. During construction, potable water usage would be greater than that required under the No-Action Alternative. As a result, average daily water consumption on Cape Canaveral AS would increase slightly between 1998 and 2000. The current average demand is approximately 0.75 MGD and the system has a capacity of 3 MGD; no impacts are anticipated during construction.

Employment decreases as a result of implementing Concept A would reduce the requirements for potable water on station by approximately 43,700 gpd by 2015, or approximately 6 percent. Deluge water required to support launches would consume approximately 1.2 million gallons during the peak launch year (2015). This is 0.6 million gallon less than that estimated for the No-Action Alternative, or a 34-percent decrease. Reductions in potable water from domestic and industrial uses under Concept A would be approximately 45,200 gpd, and no impacts to the potable water system are expected on station. Project-related population decreases within the ROI would reduce potable water consumption off-station by approximately 60,300 gpd. These changes in potable water requirements are not expected to have any impacts on regional water systems, and the systems would continue to operate within capacity.

Wastewater. Construction of facilities would increase wastewater generation between 1998 and 2000. The current system has a permitted capacity of 0.8 MGD and a peak daily flow of approximately 0.6 MGD. The increase can be absorbed by the existing system, and no impacts are anticipated.

During the operational phase, employment on station would decrease and the amount of wastewater would decrease. By the peak launch year (2015), wastewater generation is expected to be reduced by approximately 43,700 gpd, which would result in an on-station reduction of wastewater requiring treatment and disposal of approximately 7 percent. The amount of wastewater associated with Concept A launches would be approximately 464,000 gallons less than that estimated for the No-Action Alternative in 2015. During that year, approximately 80 percent of deluge water, or 920,000 gallons, used during launch activities would be discharged to percolation ponds near the launch pad or would be routed to the existing treatment plant on-site for treatment. The WWTP can treat approximately 200,000 gpd of contaminated deluge water, if required. The daily peak flow is expected to be approximately 0.55 MGD, and the WWTP would continue to operate within capacity.

Population decreases would reduce wastewater generation within the ROI and would result in a reduction of the requirements for wastewater treatment and disposal off station by approximately 40,200 gpd. Regional systems would continue to operate within capacity, and no impacts are anticipated.

Solid Waste. Several thousand tons of construction debris are expected to be generated over the 2-year construction period as a result of facility demolition, construction, and modification. Of this, approximately 3 to 5 percent of construction solid waste is expected to be recycled; the rest would be disposed of in the on-station construction landfill, which has approximately 7 acres of permitted capacity for construction and demolition debris.

During the operational phase, solid waste generated would be approximately 1.9 tons per day less than that of the No-Action Alternative, reducing the amount of solid waste generated on station by approximately 23 percent in 2015. Project-related population decreases within the ROI would reduce the generation of solid waste by approximately 1.4 tons per day. The combined reduction is expected to reduce the amount of solid waste disposed in the

Brevard County Landfill by 3.3 tons per day in 2015, which would be a beneficial impact on solid waste disposal facilities within the region.

Electricity. Increases in electrical consumption during construction are expected to be minimal. During the operational phase, electricity consumption would increase slightly as the result of new facilities being operated on the station. However, this increase in electrical consumption would not impact the station's electrical distribution system. No measurable changes in electrical consumption as a result of Concept A are expected to occur off station within the ROI. Therefore, no impacts to electrical consumption are expected.

4.5.1.1.2 Concept A, Vandenberg AFB

Water Supply. During construction, potable water usage would exceed that required under the No-Action Alternative. As a result, average daily water consumption on Vandenberg AFB would increase slightly between 2000 and 2002. The existing system would be capable of absorbing the increase, and no impacts are anticipated during construction.

By 2007, employment decreases as a result of Concept A implementation would reduce the requirements for potable water on base by approximately 23,000 gpd, or approximately 0.7 percent. Deluge water requirements for launch activities are expected to be 500,000 gallons, approximately 280,000 gallons less than that needed under the No-Action Alternative during the peak launch year (2007). Reductions in potable water from domestic and industrial uses under Concept A would be approximately 24,000 gpd, and no impacts to the potable water system would occur on the base. Project-related population decreases within the ROI would reduce potable water consumption by approximately 36,600 gpd. These changes are not expected to have any impacts on regional water systems, and the systems would continue to operate within capacity.

Wastewater. Construction of facilities to support Concept A would slightly increase wastewater generation between 2000 and 2002. The existing system is capable of absorbing the increase. Therefore, no impacts are anticipated during construction.
During the operational phase of EELV, employment on base as a result of Concept A would decrease and the amount of wastewater generated would be reduced. By the peak launch year (2007), daily wastewater generation is expected to be reduced by approximately 23,000 gpd, which would result in an on-base reduction of wastewater requiring treatment and disposal of approximately 1.8 percent.

Project-related population decreases would reduce wastewater generation within the project's ROI and would result in a reduction of the requirements for wastewater treatment and disposal off base by 24,400 gpd. The combined reduction is expected to reduce the amount of wastewater treatment and disposal in Lompoc Regional WWTP by 47,400 gpd by 2007. These reductions in wastewater are not expected to impact wastewater treatment and disposal facilities.

Approximately 80 percent, or 400,000 gallons, of deluge water used during launch activities would be collected and transported by tanker truck with a capacity of 2,000 to 4,000 gallons per load from the origination point to the IWTP during the peak launch year. The wastewater generation associated with Concept A launches would be 224,000 gallons less than that estimated for the No-Action Alternative in 2007. The IWTP is currently using only one pond pending the completion of the engineering analysis for integrity. Each launch event would generate approximately 40,000 gallons of wastewater, which would require up to 20 truck trips from the launch pad to the IWTP and up to 44 days for disposal in the existing evaporation pond. This would be 60 fewer truck trips and up to 132 fewer days of evaporation per launch than those estimated for the No-Action Alternative. This would result in deluge wastewater generation that is less than that experienced under current operations. The IWTP would continue to operate within capacity.

Solid Waste. Several thousand tons of construction debris are expected to be generated over the 2-year construction period as a result of facility demolition, construction, and modification. Of this, approximately 3 to 5 percent of construction solid waste is expected to be recycled; the rest would be disposed of in the on-base construction landfill, which has a 95-year life.

During the operational phase, the amount of solid waste generated would be approximately 1 ton per day, or approximately 1.7 percent less than that of the No-Action Alternative. Project-related population decreases within the ROI related to Concept A would reduce the generation of solid waste by approximately 0.9 ton per day by 2007, which would be a beneficial impact on the solid waste disposal facilities within the region.

Electricity. Increases in electrical consumption during construction are expected to be minimal. During the operational phase, electricity consumption would increase slightly as the result of new facilities being operated on the base. However, the increase in electrical consumption would not impact the base’s electrical distribution system. No measurable changes in electrical consumption as a result of Concept A are expected to occur off base within the ROI. Therefore, no impacts to electrical consumption are expected.

4.5.1.2 Concept B

4.5.1.2.1 Concept B, Cape Canaveral AS

Water Supply. During construction, potable water use would be approximately 3,300 gpd greater than use by existing launch programs, and average daily water consumption on Cape Canaveral AS would increase by less than one-half percent. No impacts are anticipated.

Project-related employment decreases would reduce the requirements for potable water on station by approximately 30,200 gpd, or approximately 4 percent, by 2015. There are currently no plans to use deluge water for Concept B launches. However, washdown of the pad after a launch using solid boosters would consume approximately 6,000 gallons of potable water, or 36,000 gallons during the peak launch year, or approximately 2 percent of the deluge water estimated for the No-Action Alternative in 2015. Reductions in potable water from domestic and industrial uses under Concept B would be approximately 34,800 gpd, and no impacts to the potable water system on the station would occur. Project-related population decreases within the ROI would reduce potable water consumption off-station by approximately 42,800 gpd. These changes in potable water requirements are not expected to have any impacts on regional water systems, and the systems would continue to operate within capacity.

Wastewater. Construction of facilities to support Concept B would generate approximately 2,000 gallons of wastewater each day between 1998 and 2000, adding less than one-half of 1 percent to the wastewater disposal and treatment facility on Cape Canaveral AS. The WWTP would continue to operate within capacity, and no impacts are anticipated during construction.

During the operational phase, employment on station as a result of Concept B implementation would decrease and therefore would reduce the generation of wastewater. By the peak launch year (2015), wastewater generation is expected to be reduced by approximately 30,200 gpd, which would result in an on-station reduction of wastewater requiring treatment and disposal of approximately 5 percent. Wastewater generation associated with Concept B launches would be 1,348,000 gallons less than estimated for the No-Action Alternative in 2015. Approximately 36,000 gallons of deluge water used during launch activities would be discharged to percolation ponds near the launch pad or be routed to the existing treatment plant on site in 2015. The WWTP can treat approximately 200,000 gpd of contaminated deluge water, if required. The daily peak flow is expected to be approximately 0.57 MGD and the WWTP would continue to operate within its permitted capacity. Project-related population decreases would reduce wastewater generation within the ROI and would result in a reduction of the requirements for wastewater treatment and disposal off station by approximately 28,500 gpd. Regional systems would continue to operate within capacity, and no impacts are anticipated.

Solid Waste. Approximately 5,000 to 8,000 tons of construction debris are expected to be generated over the 2-year construction period as a result of facility demolition and modification. Of this, approximately 150 to 400 tons are expected to be recycled, with fewer than 11 tons per day requiring disposal. It is expected that the disposal would occur in the on-station construction landfill, which has approximately 7 acres of permitted capacity for construction and demolition debris disposal.

During the operational phase, solid waste generated would be less than that of the No-Action Alternative by approximately 1.3 tons per day. This would reduce the amount of solid waste generated on station by approximately 16 percent in 2015. Project-related population decreases within the ROI would reduce the generation of solid waste by approximately 1 ton per day. The combined reduction is expected to reduce the amount of solid waste disposed in the Brevard County Landfill by 2.3 tons per day in 2015, which would be a beneficial impact on the solid waste disposal facilities within the region.

Electricity. Increases in electrical consumption during construction are expected to be minimal. During the operational phase, electricity consumption would increase slightly as the result of new facilities being operated on the station. However, this increase in electrical consumption would not impact the station's electrical distribution system. No measurable changes in electrical consumption as a result of Concept B activities are expected to occur off station within the ROI. Therefore, no impacts to electrical consumption are expected.

4.5.1.2.2 Concept B, Vandenberg AFB

Water Supply. During construction, potable water usage would exceed that required by the No-Action Alternative. As a result, average daily water consumption on Vandenberg AFB would increase slightly between 1998 and 2001. The existing system would be capable of absorbing the increase, and no impacts are anticipated during construction.

By 2007, employment decreases as a result of Concept B implementation would reduce the requirements for potable water on base by approximately 11,100 gpd, or approximately 0.3 percent, by 2007. There are currently no plans to use deluge water for Concept B launches. However, water flushing at the pad after a launch using solid boosters would consume approximately 6,000 gallons of potable water, or 24,000 gallons during the peak launch year. Flushing water usage associated with Concept B launches would be only 3 percent of the deluge water estimated for the No-Action Alternative by 2007. Reductions in potable water from domestic and industrial uses under Concept B would be approximately 13,000 gpd, and no impacts to the potable water system would occur on the base. Project-related population decreases within the ROI would reduce potable water consumption by approximately 18,800 gpd off base. These changes are not expected to have any impacts on regional water systems, and the systems would continue to operate within capacity.

Wastewater. Construction of facilities to support Concept B would generate approximately 2,000 gallons of wastewater between 1998 and 2001. As a result, the additional wastewater would add less than one-half of 1 percent to the wastewater disposal and treatment facility. The existing system is capable of absorbing the increase. Therefore, no impacts are anticipated during construction.

During the operational phase, employment on base as a result of Concept B implementation would decrease and the amount of wastewater generated would be reduced. By the peak launch year (2007), daily wastewater generation is expected to be reduced by approximately 11,100 gpd, which would result in an on-base reduction of wastewater requiring treatment and disposal of approximately 0.9 percent.

Project-related population decreases would reduce wastewater generation within the ROI and would result in a reduction of the requirements for wastewater treatment and disposal off base by 12,500 gpd. The combined reduction is expected to reduce the amount of wastewater treatment and disposal in Lompoc Regional WWTP by 23,600 gpd in 2007. Reductions in wastewater from domestic uses are not expected to exceed current operations, and no impacts to wastewater treatment and disposal would occur within the region.

Flushing water used after launches would be collected and transported by tanker trucks with a capacity of 2,000 to 4,000 gallons per load from the origination point to IWTP and discharged directly into the evaporation ponds. Flushing water associated with Concept B launches would be 600,000 gallons less than the deluge water estimated for the No-Action Alternative in 2007. The IWTP is currently using only one pond pending the completion of the engineering analysis for integrity. Each launch event would generate 6,000 gallons of wastewater, which would require up to 3 truck trips and up to 7 days for disposal in the existing evaporation pond. This would be 77 fewer truck trips and up to 169 fewer days of evaporation per launch than those estimated for the No-Action Alternative. This would result in industrial wastewater generation that is less than that experienced under current operations. The IWTP would continue to operate within capacity.

Solid Waste. Approximately 5,000 to 8,000 tons of construction debris are expected to be generated over the 30-month construction period as a result of facility demolition, construction, and modification. Of this, approximately 150 to 400 tons are expected to be recycled, fewer than 8.5 tons per day would be disposed in the on-base construction landfill, which has a 95-year life.

During the operational phase, the amount of solid waste generated would be approximately 0.5 ton per day less than that of the No-Action Alternative. This would reduce the amount of solid waste generated on base by approximately 0.8 percent by 2007. Project-related population decreases within the ROI related to the Concept B program would reduce the generation of solid waste by approximately 0.4 ton per day in 2007, which would be a beneficial effect on the solid waste disposal facilities within the region.

Electricity. Increases in electrical consumption during construction are expected to be minimal. During the operational phase, electricity consumption would increase slightly as the result of new facilities being operated on the base. However, the increase in electrical consumption would not impact the base’s electrical distribution system. No measurable changes in electrical consumption as a result of Concept B activities are expected to occur off base within the ROI. Therefore, no impacts to electrical consumption are expected. No adverse impacts are anticipated; therefore, no mitigation measures would be required.

4.5.1.3 Concept A/B

4.5.1.3.1 Concept A/B, Cape Canaveral AS

Water Supply. During construction, potable water use would be greater than use by existing systems, and average daily water consumption on Cape Canaveral AS would increase slightly. No impacts are anticipated.

Project-related employment decreases would reduce the requirements for potable water on station by approximately 27,900 gpd by 2015, or approximately 3.7 percent. Deluge and flushing water required to support launches would consume approximately 674,000 gallons of potable water during the peak launch year. This is approximately 1,050,000 gallons of potable water usage less than estimated for the No-Action Alternative, or a 61-percent decrease. Reductions in potable water from domestic and industrial uses under Concept A/B would be approximately 30,000 gpd, and no impacts to the potable water system on the station would occur. Project-related population decreases within the ROI would reduce potable water consumption off station by approximately 43,000 gpd. These changes in potable water requirements are not expected to have any impacts on regional water systems, and the systems would continue to operate within capacity.

Wastewater. Construction of facilities to support Concept A/B would slightly increase wastewater generation between 1998 and 2000. The WWTP would continue to operate within capacity and no impacts are anticipated during construction.

During the operational phase, employment on station as a result of Concept A/B would decrease and therefore would reduce the generation of wastewater. By the peak launch year, wastewater generation is expected to be reduced by approximately 27,900 gpd, which would result in an on-station reduction of wastewater requiring treatment and disposal of approximately 4.5 percent. The total amount of wastewater associated with Concept A/B launches would be 840,000 gallons less than that estimated for the No-Action Alternative by 2015. Approximately 544,000 gallons of deluge and flushing water used during launch activities would be discharged into percolation ponds near the launch pad during the peak launch year or routed to the treatment plant on-site for treatment. The WWTP can treat approximately 200,000 gpd as an alternative to discharging wastewater into percolation ponds. The daily peak flow in 2015 is expected to be approximately 0.57 MGD, and the WWTP would continue to operate within capacity. Project-related population decreases would reduce wastewater generation within the ROI and would result in a reduction of the requirements for wastewater treatment and disposal off station by approximately 28,700 gpd. Regional systems would continue to operate within capacity and no impacts are anticipated.

Solid Waste. Several thousand tons of construction debris are expected to be generated over the 2-year construction period as a result of facility demolition and modification. Of this, approximately 3 to 5 percent of construction solid waste is expected to be recycled; the rest would require disposal. It is expected that the disposal would occur in the on-station construction landfill, which has over 127 acres of potential available capacity. Approximately 7 acres of permitted capacity are for construction and demolition debris disposal.

During the operational phase, solid waste generated by the employees would decrease over that of the No-Action Alternative by approximately 1.2 tons per day. This would reduce the amount of solid waste generated on station by approximately 15 percent by 2015. Project-related population decreases within the ROI would reduce the generation of solid waste by approximately 1 ton per day. The combined reduction is expected to reduce the amount of solid waste disposed in the Brevard County Landfill by 2.2 tons per day in

2015, which would be a beneficial impact on the solid waste disposal facilities within the region.

Electricity. Increases in electrical consumption during construction are expected to be minimal. During the operational phase, electricity consumption would increase slightly as the result of new facilities being operated on the station. However, this increase in electrical consumption would not impact the station's electrical distribution system. No measurable changes in electrical consumption as a result of Concept A/B activities are expected to occur off station within the ROI. Therefore, no impacts to electrical consumption are expected.

4.5.1.3.2 Concept A/B, Vandenberg AFB

Water Supply. During construction, potable water usage would exceed that required under the No-Action Alternative. As a result, average daily water consumption on Vandenberg AFB would increase slightly between 1998 and 2002. The existing system would be capable of absorbing the increase and no impacts are anticipated during construction.

Employment decreases as a result of Concept A/B implementation would reduce the requirements for potable water on base by approximately 10,400 gpd by 2007, or approximately 0.3 percent. Deluge and flushing water requirements for launch activities are expected to be 374,000 gallons, approximately 400,000 gallons less than needed under the No-Action Alternative during the peak launch year, or a 52-percent decrease. Reductions in potable water from domestic and industrial uses under Concept A/B would be approximately 12,000 gpd, and no impacts to the potable water system would occur on the base. Project-related population decreases within the ROI would reduce potable water consumption by approximately 20,000 gpd off base. These changes are not expected to have any impacts on regional water systems, and the systems would continue to operate within capacity.

Wastewater. Construction of facilities to support Concept A/B would increase the generation of wastewater between 1998 and 2002. The existing system would be capable of absorbing the increase. Therefore, no impacts are anticipated during construction.

During the operational phase, employment on base as a result of Concept A/B implementation would decrease and the amount of wastewater generated would be reduced. By the peak launch year, daily wastewater generation is expected to be reduced by approximately 10,400 gpd, which would result in an on-base reduction of wastewater requiring treatment and disposal of approximately 0.8 percent.

Project-related population decreases would reduce wastewater generation within the project's ROI and would result in a reduction of the requirements for wastewater treatment and disposal off base by 13,300 gpd. The combined reduction is expected to reduce the amount of wastewater treatment and disposal in Lompoc Regional WWTP by 23,700 gpd in 2007. These reductions are not expected to impact wastewater treatment and disposal facilities.

Approximately 300,000 gallons of deluge and flushing water used during launch activities would be collected and transported by tanker trucks with a capacity of 2,000 to 4,000 gallons per load from the origination point to the IWTP during the peak launch year. This amount would be 320,000 gallons less than estimated for the No-Action Alternative by 2007. The IWTP is currently using only one pond pending the completion of the engineering analysis for integrity. Each launch event would generate up to 40,000 gallons of wastewater, which would require up to 20 truck trips and up to 44 days for disposal in the existing evaporation pond. This would be 77 fewer truck trips and up to 169 fewer days of evaporation per launch over those estimated for the No-Action Alternative. This would result in industrial wastewater generation that is less than that experienced under current operations. The IWTP would continue to operate within capacity.

Solid Waste. Several thousand tons of construction debris are expected to be generated over the 3.5-year construction period as a result of facility demolition and modification. Of this, approximately 3 to 5 percent is expected to be recycled; the rest would require disposal. It is expected that the disposal would occur in the on-base construction landfill, which has a 95-year life.

During the operational phase, the amount of solid waste generated would be approximately 0.5 ton per day less than that of the No-Action Alternative. This would reduce the amount of solid waste generated on base by approximately 0.8 percent by 2007. Project-related population decreases within the ROI related to Concept A/B would reduce the generation of solid waste by approximately 0.5 ton per day, which would be a beneficial impact on the solid waste disposal facilities within the region.

Electricity. Increases in electrical consumption during construction are expected to be minimal. During the operational phase, electricity consumption would increase slightly as the result of new facilities being operated on the base. However, this increase in electrical consumption is not expected to impact the base's electrical distribution system. No measurable changes in electrical consumption as a result of Concept A/B activities are expected to occur off base within the ROI. Therefore, no impacts to electrical consumption are expected.

4.5.2 No-Action Alternative

4.5.2.1 Cape Canaveral AS

Utility consumption for government launch programs at Cape Canaveral AS would continue at current levels, as described in Section 3.5.1, and all systems would continue to operate within capacity. No impacts are anticipated.

4.5.2.2 Vandenberg AFB

Utility consumption for government launch programs at Vandenberg AFB would continue at current levels, as described in Section 3.5.2, and all systems would continue to operate within capacity. No impacts are anticipated.

4.6 HAZARDOUS MATERIALS AND HAZARDOUS WASTE MANAGEMENT

This section addresses potential environmental impacts caused by hazardous materials/waste management practices associated with the Proposed Action and No-Action Alternative, including the potential impacts on the ongoing remediation activities at existing contaminated sites.

The Air Force will continue to remediate all contamination associated with sites proposed for use under the EELV program. Delays or restrictions on facility use or launch sites may occur depending on the extent of contamination and the results of remedial actions determined for contaminated sites.

Regulatory standards and guidelines have been applied in determining the potential impacts associated with the use of hazardous materials and the generation of hazardous wastes. The following criteria were used to identify potential impacts:

- Amount of hazardous materials brought onto the installations to support the EELV program that could result in exposure to the environment or public through release or disposal practices
- Hazardous waste generation that could increase regulatory requirements
- Pollution prevention practices to be utilized during the EELV program to prevent and/or improve environmental impacts associated with launch operations
- EELV program activities that would affect IRP activities.

4.6.1 Proposed Action

4.6.1.1 Concept A

Activities proposed under Concept A were analyzed for their potential to impact the existing hazardous material and waste management programs. The impact analysis was conducted by comparing the amount of hazardous materials/waste associated with the EELV program to quantities utilized for current launch vehicle systems. Table 4.6-1 presents the quantities of hazardous waste that would be generated under Concept A.

Table 4.6-1. Hazardous Waste Generated Per Launch, Concept A[(a)]

RCRA Hazardous Waste	Quantity (lbs) MLV	Quantity (lbs) HLV
Ignitable DOO1 RCRA Wastes	980	1,340
Halogenated Solvents FOO1/FOO2 RCRA Wastes	0	0
Toxic DOO4 EPA Wastes	40	110
Corrosive DOO2 RCRA Waste	5,500	5,500
Commercial Chemical Products (U) RCRA Wastes	3,100	3,100
Acutely Hazardous Waste (P) RCRA Wastes	0	0
Reactive DOO3 RCRA Wastes	500	500
State-Regulated Wastes	0	0
Miscellaneous Wastes	50	50
Total	10,170	10,600

Note: (a) Data provided by contractor.

HLV = heavy lift variant
lbs = pounds
MLV = medium lift variant
RCRA = Resource Conservation and Recovery Act

4.6.1.1.1 Concept A, Cape Canaveral AS

Hazardous Materials Management. The types of hazardous materials proposed for use for Concept A activities would be similar to those used at Cape Canaveral AS for current launch vehicle programs. Table 4.6-2 provides a comparison of hazardous materials to be used per launch and in the peak year (2015) for Concept A with the quantities utilized for current launch vehicle systems.

Implementation of Concept A would increase the amount of hazardous materials used on Cape Canaveral AS by approximately 190,000 pounds per year. This increase in hazardous material use is due to the increased number of annual launches under Concept A compared to current programs.

Although launch rates would increase, less processing would occur on site. Launch vehicle components would be shipped to Cape Canaveral AS in flightworthy condition, reducing on-site prelaunch preparations. Payload

Table 4.6-2. Total Hazardous Materials Used for Concept A and for Current Launch Vehicle Systems, Cape Canaveral AS[(a)]

Launch Vehicle System	Number of Launches	Hazardous Materials Used (lbs/launch)	Total Hazardous Materials Used in 2015 (lbs)
EELV Concept A[(b)]			374,830
MLV	22	15,850	
HLV	1	26,130	
No-Action Alternative[(b)(c)]			184,520
Atlas IIA	7	17,670	
Delta II	3	7,210	
Titan IVB	1	39,200	

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant
lbs = pounds
MLV = medium lift variant

fairings would arrive cleaned, bagged, and ready for storage. No cleaning of payload fairings would occur on site, reducing the amount of hazardous materials utilized for on-site launch processing.

The amount of liquid propellants stored on the installation would increase due to the increased number of launches; no solid rocket motor propellant would be utilized. Table 2.1-1 and 2.2-2 list propellant quantities for Concept A and the No-Action Alternative, respectively.

Cape Canaveral AS has the mechanisms in place to store and manage the increased quantity of hazardous materials, including liquid propellants. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials/fuels.

Hazardous Waste Management. The types of hazardous waste generated under Concept A would be similar to wastes generated by current launch vehicle systems. Table 4.6-3 provides a comparison of the quantities of hazardous waste generated per launch and in the peak year (2015) for Concept A to the quantities generated by current programs.

Implementation of Concept A would increase the amount of hazardous waste generated on Cape Canaveral AS by approximately 83,000 pounds per year. This increase in hazardous waste generation is due to the increased number of annual launches under Concept A.

Table 4.6-3. Total Hazardous Waste Generation for Concept A and for Current Launch Vehicle Systems, Cape Canaveral AS[a]

Launch Vehicle System	Number of Launches	Hazardous Waste Generated (lbs/launch)	Total Hazardous Waste Generated in 2015 (lbs)
EELV Concept A[b]			234,340
MLV	22	10,170	
HLV	1	10,600	
No-Action Alternative[b][c]			151,300
Atlas IIA	7	9,240	
Delta II	3	16,810	
Titan IVB	1	36,190	

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant
lbs = pounds
MLV = medium lift variant

Cape Canaveral AS has the mechanisms in place to store, manage, and dispose of hazardous waste, including additional propellant waste. Hazardous wastes would be handled in accordance with all federal, state, and Air Force regulations. Since wastes from Concept A would be similar to wastes currently handled by Cape Canaveral AS, no adverse impacts are anticipated.

Pollution Prevention. As required under Air Force pollution prevention goals, Cape Canaveral AS must reduce hazardous waste disposal by 50 percent by December 31, 1997, from their 1992 baseline. The increased volume of hazardous waste generation under Concept A could affect the installation's ability to meet this goal. Concept A activities should be coordinated with installation environmental personnel to reduce the impact of increased hazardous waste on pollution prevention goals.

No Class I ODSs would be used for any Concept A activities at Cape Canaveral AS. The only potential use for Class II ODSs is the use of refrigerants in the heating, ventilation and air conditioning (HVAC) system. Shipping components to the launch site in flightworthy condition and minimizing prelaunch processing would reduce pollution at the site. A Hazardous Material Management Plan would be prepared to outline plans to reduce to as near zero as possible the use of Class II ODSs and EPCRA 313 chemicals.

Installation Restoration Program. The PCB-contaminated soil at SLC-41 will be addressed prior to commencement of EELV construction activities. Some areas of contamination may be paved over (capped) prior to construction in lieu of disturbing the contaminated soil. Prior to beginning construction at SLC-41, activities would be coordinated through IRP personnel to minimize impacts to remediation activities and EELV program activities.

Although groundwater contamination is present at the VIB (Building 70500), no construction is proposed at this site under the EELV program. IRP investigations at the VIB would not be impacted by Concept A activities.

Compliance with all applicable federal, state, local, and Air Force regulations regarding the use, storage, handling, and disposal of hazardous substances would reduce the potential for impacts; therefore, no mitigation measures would be required.

4.6.1.1.2 Concept A, Vandenberg AFB

Hazardous Materials Management. The types of hazardous materials proposed for use for Concept A activities would be similar to those used at Vandenberg AFB for current launch vehicle programs. Table 4.6-4 provides a comparison of the quantities of hazardous materials to be used per launch and in the peak year (2007) for Concept A with the quantities utilized for current launch vehicle systems.

Table 4.6-4. Total Hazardous Materials Used for Concept A and for Current Launch Vehicle Systems, Vandenberg AFB[(a)]

Launch Vehicle System	Number of Launches	Hazardous Materials Used (lbs/launch)	Total Hazardous Materials Used in 2007 (lbs)
EELV Concept A[(b)]			158,500
MLV	10	15,850	
HLV	0	26,130	
No-Action Alternative[(b)(c)]			74,640
Atlas IIA	3	17,670	
Delta II	3	7,210	
Titan IVB	0	39,200	

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant
lbs = pounds
MLV = medium lift variant

Implementation of Concept A would increase the amount of hazardous materials used on Vandenberg AFB by approximately 84,000 pounds per year. This increase in hazardous material use is due to the increased number of annual launches under Concept A compared to current programs. Although launch rates are scheduled to increase, less processing would occur on site, as discussed in Section 4.6.1.1.1.

The amount of liquid propellant stored on the installation would increase due to the increase in number of launches; no solid rocket motor propellant would be required. Tables 2.1-1 and 2.2-2 list propellant quantities for Concept A and the No-Action Alternative, respectively.

Vandenberg AFB has the mechanisms in place to store and manage the increased quantity of hazardous materials, including liquid propellant. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials/fuels.

Hazardous Waste Management. The types of hazardous waste generated under Concept A would be similar to wastes generated by current launch vehicle systems. Table 4.6-5 provides a comparison of the quantities of hazardous waste generated per launch and in the peak year (2007) for Concept A to the quantities generated by current programs.

Table 4.6-5. Total Hazardous Waste Generation for Concept A and for Current Launch Vehicle Systems, Vandenberg AFB[(a)]

Launch Vehicle System	Number of Launches	Hazardous Waste Generated (lbs/launch)	Total Hazardous Waste Generated in 2007 (lbs)
EELV Concept A[(b)]			101,700
MLV	10	10,170	
HLV	0	10,600	
No-Action Alternative[(b)(c)]			78,150
Atlas IIA	3	9,240	
Delta II	3	16,810	
Titan IVB	0	36,190	

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant
lbs = pounds
MLV = medium lift variant

Implementation of Concept A would increase the amount of hazardous waste generated on Vandenberg AFB by approximately 23,500 pounds per year. This increase in hazardous waste generation is due to the increased number of annual launches under Concept A compared to current programs. Vandenberg AFB has the mechanisms in place to store, manage, and dispose of hazardous waste, including additional propellant waste. Hazardous wastes would be handled in accordance with all federal, state, and Air Force regulations. Since wastes from Concept A would be similar to wastes currently handled by Vandenberg AFB, no adverse impacts are anticipated.

Pollution Prevention. Pollution prevention impacts on Vandenberg AFB from Concept B activities are the same as discussed for Cape Canaveral in Section 4.6.1.1.1.

Installation Restoration Program. IRP Site 6, located at SLC-3W, has been recommended for NFRAP. EELV construction activities would not impact investigations at the site. EELV activities are not expected to impact investigations at IRP Site 7, Bear Creek Pond.

There are several AOCs associated with the SLC-3 area and one AOC at Building 7525 that could delay proposed EELV construction activities. It has not yet been determined whether these sites require remediation; further investigations are planned.

Compliance with all applicable federal, state, local, and Air Force regulations regarding the use, storage, handling, and disposal of hazardous substances would reduce the potential for impacts; therefore, no mitigation measures would be required.

4.6.1.2 Concept B

Activities proposed under Concept B were analyzed for their potential impacts on the existing hazardous material and waste management programs from associated hazardous material usage and waste generation. The impact analysis was conducted by comparing the amount of hazardous material/ waste associated with the EELV program to quantities utilized for current launch vehicle systems. Table 4.6-6 presents the quantities of hazardous waste that would be generated under Concept A.

4.6.1.2.1 Concept B, Cape Canaveral AS

Hazardous Materials Management. The types of hazardous materials proposed for use for Concept B activities would be similar to those used at Cape Canaveral AS for current launch vehicle programs. Table 4.6-7 provides a comparison of hazardous materials to be used per launch and in the peak year (2015) for Concept B with the quantities utilized for current launch vehicle systems.

Table 4.6-6. Hazardous Waste Generated Per Launch, Concept B[a]

Hazardous Waste Generated Per Launch	Quantity (lbs)
Ignitable DOO1 RCRA Wastes	3,570
Halogenated Solvents FOO1/FOO2 RCRA Wastes	0
Non-halogenated Solvents FOO3/FOO4/F005 RCRA	890
Corrosive DOO2 RCRA Wastes	5,500
Toxic DOO4-DOO12 RCRA Wastes	1,700
Commercial Chemical Products (U) RCRA Wastes	430
Acutely Hazardous Waste (P) RCRA Wastes	0
Reactive DOO3 RCRA Wastes	20
State-Regulated Wastes	10,500
Miscellaneous (Remediation) Wastes	4,340
Total	26,950

Note: (a) Data provided by contractor.
lbs = pounds
RCRA = Resource Conservation and Recovery Act

Table 4.6-7. Total Hazardous Materials Used for Concept B and for Current Launch Vehicle Systems, Cape Canaveral AS[a]

Launch Vehicle System	Number of Launches	Hazardous Materials Used (lbs/launch)	Total Hazardous Materials Used in 2015 (lbs)
EELV Concept B[b]			205,390
MLV	22	8,930	
HLV	1	8,930	
No-Action Alternative[b][c]			184,520
Atlas IIA	7	17,670	
Delta II	3	7,210	
Titan IVB	1	39,200	

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy launch vehicle
lbs = pounds
MLV = medium launch vehicle

Implementation of Concept B would increase the amount of hazardous materials used on Cape Canaveral AS by approximately 21,000 pounds per year. This increase is due to the increased number of annual launches under Concept B. Although launch rates are scheduled to increase, less processing would occur on site, as discussed in Section 4.6.1.1.1.

Quantities of propellant stored on the installation would increase due to the increase in launches. Tables 2.1-6 and 2.2-2 list propellant quantities for Concept B and the No-Action Alternative, respectively.

Cape Canaveral AS has the mechanisms in place to store and manage hazardous materials, including hazardous propellants. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials/fuels.

Hazardous Waste Management. The types of hazardous waste generated under Concept B would be similar to wastes generated by current launch vehicle systems. Table 4.6-8 provides a comparison of the quantities of hazardous waste generated per launch and in the peak year (2015) for Concept B to the quantities generated by current programs.

Table 4.6-8. Total Hazardous Waste Generation for Concept B and for Current Launch Vehicle Systems, Cape Canaveral AS[(a)]

Launch Vehicle System	Number of Launches	Hazardous Waste Generated (lbs/launch)	Total Hazardous Waste Generated in 2015 (lbs)
EELV Concept B[(b)]			619,850
MLV	22	26,950	
HLV	1	26,950	
No-Action Alternative[(b)(c)]			151,300
Atlas IIA	7	9,240	
Delta II	3	16,810	
Titan IVB	1	36,190	

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy launch vehicle
lbs = pounds
MLV = medium launch vehicle

Implementation of Concept B would increase the amount of hazardous waste generated on Cape Canaveral AS by approximately 470,000 pounds per year. This increase in hazardous waste generation is due to the increased number of annual launches under Concept B compared to current programs.

The additional hazardous waste generated by Concept B activities would be handled as discussed in Section 4.6.1.1.1. Since wastes from Concept B would be similar to wastes currently handled by Cape Canaveral AS, no adverse impacts are anticipated.

Pollution Prevention. Pollution prevention impacts on Cape Canaveral AS from Concept B activities are the same as discussed for Concept A in Section 4.6.1.1.1.

Installation Restoration Program. NASA is currently investigating activities at the SLC-37 IRP site. EELV program activities and remediation activities could conflict depending on the results of the investigation and program schedules. Prior to EELV construction activities at SLC-37, coordination with IRP personnel would occur in order to minimize impacts to remediation activities and EELV program activities.

4.6.1.2.2 Concept B, Vandenberg AFB

Hazardous Materials Management. The types of hazardous materials proposed for use for Concept B activities would be similar to those used at Vandenberg AFB for current launch vehicle programs. Table 4.6-9 provides a comparison of hazardous materials to be used per launch and in the peak year (2007) for Concept B with the quantities utilized for current launch vehicle systems.

Table 4.6-9. Total Hazardous Materials Used for Concept B and for Current Launch Vehicle Systems, Vandenberg AFB[a]

Launch Vehicle System	Number of Launches	Hazardous Materials Used (lbs/launch)	Total Hazardous Materials Used in 2007 (lbs)
EELV Concept B[b]			89,300
MLV	8	8,930	
HLV	2	8,930	
No-Action Alternative[b][c]			74,640
Atlas IIA	3	17,670	
Delta II	3	7,210	
Titan IVB	0	39,200	

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy launch vehicle
lbs = pounds
MLV = medium launch vehicle

Implementation of Concept B would increase the amount of hazardous materials used on Vandenberg AFB by approximately 15,000 pounds per year. This increase in hazardous materials is due to the increased number of annual launches under Concept B compared to current programs. Although launch rates are scheduled to increase, less processing would occur on site, as discussed in Section 4.6.1.1.1.

Propellant quantities stored on the installation would increase due to the expanded launch schedule. Tables 2.1-6 and 2.2-2 list propellant quantities for Concept B and the No-Action Alternative, respectively.

Vandenberg AFB has the mechanisms in place to legally store and manage hazardous materials, including hazardous propellants. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials/fuels.

Hazardous Waste Management. The types of hazardous waste generated under Concept B would be similar to wastes generated by current launch vehicle systems. Table 4.6-10 provides a comparison of the quantities of hazardous waste generated per launch and in the peak year (2007) for Concept B to the quantities generated by current programs.

Table 4.6-10. Total Hazardous Waste Generation for Concept B and for Current Launch Vehicle Systems, Vandenberg AFB[(a)]

Launch Vehicle System	Number of Launches	Hazardous Waste Generated (lbs/launch)	Total Hazardous Waste Generated in 2007 (lbs)
EELV Concept B[(b)]			269,500
MLV	8	26,950	
HLV	2	26,950	
No-Action Alternative[(b)(c)]			78,150
Atlas IIA	3	9,240	
Delta II	3	16,810	
Titan IVB	0	36,190	

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy launch vehicle
lbs = pounds
MLV = medium launch vehicle

Implementation of Concept B would increase the amount of hazardous waste generation on Vandenberg AFB by approximately 190,000 pounds per year. This increase in hazardous waste generation is due to the increased number of annual launches.
The additional hazardous waste generated from Concept B activities would be managed as discussed in Section 4.6.1.1.2. Since wastes from Concept B would be similar to wastes currently handled by Vandenberg AFB, no adverse impacts are anticipated.

Pollution Prevention. Pollution prevention impacts on Vandenberg AFB from Concept B activities are the same as discussed for Concept A, Cape Canaveral AS, in Section 4.6.1.1.1.

Installation Restoration Program. IRP investigations will continue at AOC-89 at SLC-6. EELV activities and remediation activities could conflict depending on the results of the investigations. However, remediation, if necessary, could likely be implemented without interfering with the EELV program schedule. 30 CES/CEV would be contacted prior to any construction or modification near an IRP site. Measures should be taken to ensure worker safety during remediation if construction and modification is occurring simultaneously with clean-up activities.

4.6.1.3 Concept A/B

Concept A/B was analyzed for its potential impacts on the existing hazardous material and waste management programs from associated hazardous material usage and waste generation. Impact analysis was conducted by comparing the amount of hazardous material/waste associated with the EELV program to current launch vehicle quantities.

4.6.1.3.1 Concept A/B, Cape Canaveral AS

Hazardous Materials Management. The types of hazardous materials proposed for use for Concept A/B activities would be similar to those used at Cape Canaveral AS for current launch vehicle programs. Table 4.6-11 provides a comparison of hazardous materials to be used per launch and in the peak year (2015) for Concept A/B with the quantities utilized for current launch vehicle systems.

Implementation of Concept A/B would increase the amount of hazardous materials used on Cape Canaveral AS by approximately 148,000 pounds per year. This increase in hazardous material use is due to the increased number of annual launches.

Although launch rates are scheduled to increase, less processing would occur on site, as discussed in Section 4.6.1.1.1.

Propellant quantities stored on the installation would increase due to the expanded launch schedule. However, since solid rocket motors would not be used for Concept A, the number of solid propellants stored on Cape

Table 4.6-11. Total Hazardous Materials Used for Concept A/B and for Current Launch Vehicle Systems, Cape Canaveral AS[(a)]

Launch Vehicle System	Number of Launches	Hazardous Materials Used (lbs/launch)	Total Hazardous Materials Used in 2015 (lbs)
Concept A/B Total			332,420
EELV Concept A[(b)]			
MLV	12	15,850	
HLV	1	26,130	
EELV Concept B[(b)]			
MLV	11	8,930	
HLV	2	8,930	
No-Action Alternative[(b)(c)]			184,520
Atlas IIA	7	17,610	
Delta II	3	7,210	
Titan IVB	1	39,200	

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant (Concept A); heavy launch vehicle (Concept B)
lbs = pounds
MLV = medium lift variant (Concept A); medium launch vehicle (Concept B)

Canaveral AS would be reduced. Tables 2.1-1, 2.1-6, and 2.2-2 list propellant quantities for Concept A, Concept B, and the No-Action Alternative, respectively.

Although additional launches would increase the amount of hazardous materials stored on base, Cape Canaveral AS has the mechanisms in place to legally store and manage the materials. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials.

Section 4.7, Health and Safety, describes impacts associated with transportation of hazardous materials/fuels.

Hazardous Waste Management. The types of hazardous waste generated under Concept A/B would be similar to wastes generated by current launch vehicle systems. Table 4.6-12 provides a comparison of the quantities of hazardous waste generated per launch and in the peak year (2015) for Concept A/B to the quantities generated by current programs.

Implementation of Concept A/B would increase the amount of hazardous waste generated on Cape Canaveral AS by approximately 330,000 pounds per year. This increase in hazardous waste generation is due to the increased number of annual launches.

Table 4.6-12. Total Hazardous Waste Generated for Concept A/B and for Current Launch Vehicle Systems, Cape Canaveral AS[(a)]

Launch Vehicle System	Number of Launches	Hazardous Waste Generated (lbs/launch)	Total Hazardous Waste Generated in 2015 (lbs)
Concept A/B Total			482,990
EELV Concept A[(b)]			
MLV	12	10,170	
HLV	1	10,600	
EELV Concept B[(b)]			
MLV	11	26,950	
HLV	2	26,950	
No-Action Alternative[(b)(c)]			151,300
Atlas IIA	7	9,240	
Delta II	3	16,810	
Titan IVB	1	36,190	

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant (Concept A); heavy launch vehicle (Concept B)
lbs = pounds
MLV = medium lift variant (Concept A); medium launch vehicle(Concept B)

The additional hazardous waste generated by Concept A/B activities would be handled as discussed in Section 4.6.1.1.1. Since wastes from Concept A/B would be similar to wastes currently handled by Cape Canaveral AS, no adverse impacts are anticipated.

Pollution Prevention. Pollution prevention impacts on Cape Canaveral AS from Concept A/B activities are the same as discussed for Concept A in Section 4.6.1.1.1.

Installation Restoration Program. Both concepts would move forward under Concept A/B; therefore, effects on the IRP would be similar to the combined effects described in Sections 4.6.1.1.1 and 4.6.1.2.1.

4.6.1.3.2 Concept A/B, Vandenberg AFB

Hazardous Materials Management. The types of hazardous materials proposed for use for Concept A/B activities would be similar to those used at Vandenberg AFB for current launch vehicle programs. Table 4.6-13 provides a comparison of hazardous materials to be used per launch and in the peak year (2007) for Concept A/B with the quantities utilized for current launch vehicle systems.

Implementation of Concept A/B would increase the amount of hazardous materials used on Vandenberg AFB by approximately 98,800 pounds per

Table 4.6-13. Total Hazardous Materials Used for Concept A/B and for Current Launch Vehicle Systems, Vandenberg AFB[a]

Launch Vehicle System	Number of Launches	Hazardous Materials Used (lbs/launch)	Total Hazardous Materials Used in 2007 (lbs)
Concept A/B Total			173,460
EELV Concept A[b]			
MLV	7	15,850	
HLV	0	26,130	
EELV Concept B[b]			
MLV	5	8,930	
HLV	2	8,930	
No-Action Alternative[b][c]			74,640
Atlas IIA	3	17,670	
Delta II	3	7,210	
Titan IVB	0	39,200	

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant (Concept A); heavy launch vehicle (Concept B)
lbs = pounds
MLV = medium lift variant (Concept A); medium launch vehicle (Concept B)

year. This increase in hazardous material use is due to the increased number of annual launches.

Although launch rates are scheduled to increase, less processing would occur on site, as discussed in Section 4.6.1.1.1.

Propellant quantities stored on the installation would increase due to the expanded launch schedule. However, since solid rocket motors are not used for Concept A, the amount of solid propellants stored on Vandenberg AFB would be reduced. Tables 2.1-1, 2.1-6 and 2.2-2 list propellant quantities for Concept A, Concept B, and the No-Action Alternative, respectively.

Vandenberg AFB has the mechanisms in place to legally store and manage hazardous materials, including hazardous propellants. All activities would be conducted in accordance with existing regulations for the use and storage of hazardous materials.

Impacts associated with transportation of hazardous materials/fuels are described in Section 4.7, Health and Safety.

Hazardous Waste Management. The types of hazardous waste generated under Concept A/B would be similar to wastes generated by current launch vehicle systems. Table 4.6-14 provides a comparison of the quantities of

Table 4.6-14. Total Hazardous Waste Generated for Concept A/B and for Current Launch Vehicle Systems, Vandenberg AFB[a]

Launch Vehicle System	Number of Launches	Hazardous Waste Generated (lbs/launch)	Total Hazardous Waste Generated in 2007 (lbs)
Concept A/B Total			259,840
EELV Concept A[b]			
MLV	7	10,170	
HLV	0	10,600	
EELV Concept B[b]			
MLV	5	26,950	
HLV	2	26,950	
No-Action Alternative[b][c]			78,150
Atlas IIA	3	9,240	
Delta II	3	16,810	
Titan IVB	0	36,190	

Note: (a) Table does not include propellants.
(b) Data provided by contractor.
(c) Government launches only; no commercial launches included.
EELV = Evolved Expendable Launch Vehicle
HLV = heavy lift variant (Concept A); heavy launch vehicle (Concept B)
lbs = pounds
MLV = medium lift variant (Concept A); medium launch vehicle (Concept B)

hazardous waste generated per launch and in the peak year (2007) for Concept A to the quantities generated by current programs.

Implementation of Concept A/B would increase the amount of hazardous waste generated on Vandenberg AFB by approximately 180,000 pounds per year. This increase in hazardous waste generation is due to the increased number of annual launches.

The additional hazardous waste generated by Concept A/B activities would be handled as discussed in Section 4.6.1.1.1. Wastes from Concept A/B would be of similar nature to wastes currently handled by Vandenberg AFB; therefore, no adverse impacts are anticipated.

Pollution Prevention. Pollution prevention impacts on Vandenberg AFB from Concept A/B activities are the same as discussed for Cape Canaveral Concept A in Section 4.6.1.1.1.

Installation Restoration Program. Both concepts would move forward under Concept A/B; therefore, effects on the IRP would be similar to the combined effects described in Sections 4.6.1.1.1 and 4.6.1.2.1.

4.6.2 No-Action Alternative

4.6.2.1 Cape Canaveral AS

Under the No-Action Alternative, types and amounts of hazardous materials and hazardous waste would be similar to those used and generated on the installation under current operations. These amounts are listed in Section 3.6, Tables 3.6-1 through 3.6-6.

4.6.2.2 Vandenberg AFB

Under the No-Action Alternative, types and amounts of hazardous materials and hazardous waste would be similar to those used and generated on the installation, as under current operations. These amounts are listed in Section 3.6, Tables 3.6-1 through 3.6-6.

4.7 HEALTH AND SAFETY

4.7.1 Proposed Action

4.7.1.1 Concept A

4.7.1.1.1 Concept A, Cape Canaveral AS

Regional Safety. Cape Canaveral AS regional safety programs for Concept A launch operations would be the same as regional safety programs for the current launch operations described in Section 3.7.1.1, unless otherwise noted below.

A System Safety Program Plan (SSPP) would be prepared prior to EELV launch activities to identify and evaluate potential hazards and reduce associated risks to a level acceptable to Range Safety.

Impact debris corridors would be updated to provide EELV-specific parameters due to vehicle and payload configurations. An EELV-specific debris impact area would be calculated.

Hazardous materials, such as propellants, ordnance, and booster/payload components, would be transported in accordance with DOT regulations for interstate shipment of hazardous substances (Title 49 CFR 100-199) to ensure the shipment would not catch fire, explode, or release toxic materials. Liquid propellants used to fuel launch vehicle components would be shipped via land from manufacturing locations in the United States directly to Cape Canaveral AS. Propellants would be shipped in one of the following containers:

- MMH **-** DOT-specification MC 338 stainless steel cargo tank; non-DOT-specification 4BW stainless steel cylinder

- N_2O_4 - DOT-specification MC 338 stainless steel cargo tank; DOT-specification 105J500W stainless steel rail tank car; DOT-specification 110W500 stainless steel multi-unit tank car tanks

- RP-1 - MC 301 and MC 302 cargo tank; 1A1 drum
- LO_2; LH_2 - MC 338 cargo tank.

Special handling requirements for shipment of MMH and N_2O_4 include following certified and approved routes, extensive driver qualifications, and various state notification requirements.

On-Station Safety. On-station safety programs for Concept A launch operations would be the same as on-station safety programs for the current launch operations described in Section 3.7.1.2, unless otherwise noted herein.

For Concept A launches using the SUS, NO_2 and MMH concentrations would be predicted using REEDM prior to a launch to determine a THC. THC exposure concentrations for NO_2 and MMH would be compared to Tier 1, Tier 2, and Tier 3 exposure criteria (see Section 3.7.2.2). As a result of this comparison and risk estimation, emergency response would be provided as described in Section 3.7.2.2.

A summary of REEDM-predicted ambient air concentrations for NO_x and hydrazine compounds to assess air quality impacts during nominal and aborted Concept A launches is presented in Section 4.10.1.1.1. The REEDM-predicted concentrations are screening concentrations; a systematic search for worst-case meteorology was not conducted. It is conservatively assumed that all NO in NO_x would be converted to NO_2. Table 4.7-1 summarizes a comparison of REEDM-predicted NO_2 concentrations from a nominal and aborted launch to exposure criteria. Peak 30-minute average concentrations for nominal and aborted launches are less than Tier 1 exposure criteria.

Table 4.7-2 summarizes a comparison of REEDM-predicted hydrazine compound concentrations to exposure criteria. Peak 30-minute average hydrazine compound concentrations during aborted launches do not exceed the lowest Tier 2 value for hydrazine compounds; Tier 1 values have not been recommended for hydrazine. Based on this analysis, Cape Canaveral AS personnel and the general public are predicted not to be at risk during nominal and aborted Concept A launches.

A description of fire protection, alarm, and fire suppression systems is provided in Section 2.1.1.4. As stated in Section 2.1.1.4, the facilities

Table 4.7-1. Comparison of REEDM-Predicted NO_2 Air Concentrations to Recommended Exposure Criteria, Concept A

Vehicle	NO_2 Peak 1-Hour Average Concentration Increment (ppm)		Exposure Criteria 60-Minute TWA (ppm)
	Nominal Launch[(a)]	Abort	Tier 1
MLV-D	0.114	0.114	0.2
MLV-A	0.114	NA	0.2
HLV-L	0.162	0.057	0.2
HLV-G	0.162	NA	0.2

Note: (a) Values in a peak 30-minute concentration.
HLV = heavy lift variant
MLV = medium lift variant
NA = not applicable
NO_2 = nitrogen dioxide
ppm = parts per million
REEDM = Rocket Exhaust Effluent Diffusion Model
TWA = time-weighted average

Table 4.7-2. Comparison of REEDM-Predicted Hydrazine Compound Air Concentrations to Recommended Exposure Criteria, Concept A

Vehicle	Hydrazine Compound Peak 30-Minute Average Concentration Increment (ppm)	Lowest Exposure Criteria 60-Minute TWA (ppm)
	Abort	Tier 2[(a)]
MLV-D	0.025	2.0
MLV-A	0.0	2.0
HLV-L	0.015	2.0
HLV-G	0.0	2.0

Note: (a) Tier 1 exposure criteria do not exist.
HLV = heavy lift variant
MLV = medium lift variant
ppm = parts per million
REEDM = Rocket Exhaust Effluent Diffusion Model
TWA = time-weighted average

associated with Concept A launches would be designed to meet ESQD criteria. The FTS for Concept A vehicles is described in Section 2.1.1.1.

4.7.1.1.2 Concept A, Vandenberg AFB

Regional Safety. Vandenberg AFB regional safety programs for Concept A launch systems would be the same as regional safety programs for the current launch systems as described in Section 3.7.3.1 and 4.7.1.1.1.

Transportation of hazardous materials would occur as described in Section 4.7.1.1.1 for Cape Canaveral AS.

On-Base Safety. On-base safety programs for Concept A launch systems would be the same as on-base safety programs for the current launch systems described in Section 3.7.3.2, unless otherwise noted below. As discussed in Section 4.7.1.1.1, NO_2 and MMH would be predicted using REEDM prior to a launch to determine a THC for Concept A launches using the SUS. Section 4.7.1.1 addresses risk estimation through comparison of NO_2 and hydrazine compound exposure concentrations to Tier 1, Tier 2, and Tier 3 exposure criteria.

The REEDM-predicted NO_x and hydrazine compound air concentrations used to assess air quality impacts for nominal and aborted Concept A launches, presented in Section 4.10.1.1.1, also apply to Vandenberg AFB. Therefore, the conclusions drawn in Section 4.7.1.1.1 regarding comparison of REEDM-predicted NO_x and hydrazine compound air concentrations to exposure criteria are the same. Based on this analysis, Vandenberg AFB personnel and the general public are predicted not to be at risk during nominal and aborted Concept A launches.

Specific fire protection systems, FTSs, and ESQD criteria for Concept A launches are the same as those presented in Section 4.7.1.1.1 for Cape Canaveral AS.

4.7.1.2 Concept B

4.7.1.2.1 Concept B, Cape Canaveral AS

Regional Safety. Cape Canaveral AS regional safety programs for Concept B launch operations would be the same as regional safety programs for the current launch operations as described in Section 3.7.2.1 and 4.7.1.1.1.

Transportation of hazardous materials would occur as described in Section 4.7.1.1.1 for Cape Canaveral AS.

On-Station Safety. On-station safety programs for Concept B launch operations would be the same as on-station safety programs for the current launch operations described in Section 3.7.2.2, unless otherwise noted herein.

For Concept B launches using the HUS, NO_2, HCl, and hydrazine compound concentrations would be predicted using REEDM prior to a launch to determine a THC. Similarly, HCl concentrations would be predicted for DIV-M+ vehicle launches. THC exposure concentrations for these chemicals would be compared to Tier 1, Tier 2, and Tier 3 exposure criteria (see Section 3.7.2.2). As a result of this comparison and risk estimation, emergency response procedures would be implemented as described in Section 3.7.2.2.

A summary of REEDM-predicted ambient air concentrations for NO_x, HCl, and hydrazine compounds to assess air quality impacts during normal and aborted Concept B launches is presented in Section 4.10.1.2.1. As described in Section 4.7.1.1.1, the REEDM-predicted concentrations are screening concentrations; a systematic search for worst-case meteorology was not conducted. It is conservatively assumed that all NO in NO_x would be converted to NO_2.

Tables 4.7-3 , 4.7-4, and 4.7-5 summarize a comparison of REEDM-predicted NO_2, HCl, and hydrazine compound concentrations to exposure criteria, respectively. Estimated NO_2 and HCl exposure concentrations do not exceed Tier 1 exposure criteria. Estimated hydrazine compound exposure concentrations do not exceed the lowest Tier 2 exposure criteria for hydrazine compounds; Tier 1 values have not been recommended for hydrazine. Based on this analysis, Cape Canaveral AS personnel and the general public are predicted not to be at risk during nominal and aborted Concept B launches.

Table 4.7-3. Comparison of REEDM-Predicted NO_2 Air Concentrations to Recommended Exposure Criteria, Concept B

Vehicle	NO_2 Peak 1-Hour Average Concentration Increment (ppm)		Exposure Criteria 60-Minute TWA (ppm)
	Nominal Launch[(a)]	Abort	Tier 1
DIV-S	0.102	0.053	0.2
DIV-M	0.109	NA	0.2
DIV-M+	0.119	NA	0.2
DIV-H	0.020	NA	0.2

Note: (a) Value is a peak 30-minute concentration.
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
NA = not applicable
NO_2 = nitrogen dioxide
ppm = parts per million
REEDM = Rocket Exhaust Effluent Diffusion Model
TWA = time-weighted average

Table 4.7-4. Comparison of REEDM-Predicted HCl Concentrations to Recommended Exposure Criteria, Concept B

Vehicle	HCl Peak Puff Concentration Increment (ppm)		Exposure Criteria Ceiling Limit (ppm)
	Nominal Launch	Abort	Tier 1
DIV-M+	0.293	0.023	10.0

DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
HCl = hydrochloric acid
ppm = parts per million

A description of fire protection, alarm, and fire suppression systems is provided in Section 2.1.2.4. As stated in Section 2.1.2.4, facilities associated with Concept B launches would be designed to meet ESQD criteria. The FTS for Concept B vehicles is described in Section 2.1.2.1.

Table 4.7-5. Comparison of REEDM-Predicted Hydrazine Compound Air Concentrations to Recommended Exposure Criteria, Concept B

Vehicle	Hydrazine Compound Peak 30-Minute Average Concentration Increment (ppm)	Lowest Exposure Criteria 60-Minute TWA (ppm)
	Abort	Tier 2[a]
DIV-S	0.009	2.0
DIV-M	0.0	2.0
DIV-M+	0.0	2.0
DIV-H	0.0	2.0

Note: (a) Tier 1 exposure criteria do not exist.
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
ppm = parts per million
REEDM = Rocket Exhaust Effluent Diffusion Model
TWA = time-weighted average

4.7.1.2.2 Concept B, Vandenberg AFB

Regional Safety. Vandenberg AFB regional safety programs for Concept B launch operations would be the same as regional safety programs for the current launch operations as described in Section 3.7.2.1 and 4.7.1.1.1.

Transportation of hazardous materials would occur as described in Section 4.7.1.1.1 for Cape Canaveral AS.

On-Base Safety. On-base safety programs for Concept B launch operations would be the same as on-base safety programs for the current launch operations described in Section 3.7.2.2, unless otherwise noted herein.

Specific FTS, ESQD criteria, and site security measures for Concept B launches are the same as those presented in Section 4.7.1.2.1 for Cape Canaveral AS. The fire protection systems are the same as those described in Section 4.7.1.2.1, except at Vandenberg AFB, where an existing tank above the launch complex would be utilized for fire suppression.

As discussed in Section 4.7.1.2.1, NO_2, HCl (for the DIV-M+ vehicle only), and hydrazine compound concentrations would be predicted using REEDM prior to a launch to determine a THC for applicable Concept B launches. Section 4.7.1.1.1 discusses risk estimation through comparison of NO_2, HCl, and hydrazine compound exposure concentrations to Tier 1, Tier 2, and Tier 3 exposure criteria.

The REEDM-predicted NO_x, HCl, and hydrazine compound air concentrations to assess air quality impacts for nominal and aborted Concept B launches, presented in Section 4.10.1.2.1, also apply to Vandenberg AFB. Therefore, the conclusions drawn in Section 4.7.1.2.1 regarding comparison of REEDM-predicted NO_x, HCl, and hydrazine compound air concentrations to exposure criteria are the same. Based on this analysis, Vandenberg AFB personnel and the general public are predicted not to be at risk during nominal and aborted Concept B launches.

4.7.1.3 Concept A/B

4.7.1.3.1 Concept A/B, Cape Canaveral AS

Regional Safety. Cape Canaveral AS regional safety programs for Concept A/B launch operations would be the same as regional safety programs for Concept A (Section 4.7.1.1.1) and Concept B (Section 4.7.1.2.1) launch.

On-Station Safety. Cape Canaveral AS on-station safety programs for Concept A/B launch operations would be the same as on-station safety programs for Concept A (Section 4.7.1.1.1) and Concept B (Section 4.7.1.2.1) launch operations. Conclusions regarding REEDM-predicted toxic air concentrations to assess air quality impacts for nominal and aborted launches would be the same as for Concept A and Concept B launch operations.

Based on this analysis, Cape Canaveral AS personnel and the general public are predicted not to be at risk during nominal and aborted Concept A/B launches.

4.7.1.3.2 Concept A/B, Vandenberg AFB

Regional Safety. Vandenberg AFB regional safety programs for Concept A/B launch operations would be the same as regional safety programs for Concept A (Section 4.7.1.1.2) and Concept B (Section 4.7.1.2.2) launch operations.

On-Base Safety. Vandenberg AFB on-base safety programs for Concept A/B launch operations would be the same as on-base safety programs for Concept A (Section 4.7.1.1.2) and Concept B (Section 4.7.1.2.2) launch operations. Conclusions regarding REEDM-predicted toxic air concentrations to assess air quality impacts for nominal and aborted launches would be the same as for Concept A and Concept B launch operations.

Based on this analysis, Vandenberg AFB personnel and the general public are predicted not to be at risk during nominal and aborted Concept A/B launches.

4.7.2 No-Action Alternative

4.7.2.1 Cape Canaveral AS. The current regional and on-station safety programs described in Section 3.7.2 would remain in effect. Some vehicles would utilize solid rocket motors and would therefore produce an HCl toxic plume. However, Cape Canaveral AS personnel and the general public are predicted not to be at risk during nominal or aborted launches. Under the No-Action Alternative, no additional health and safety risks would be incurred beyond current operating levels.

4.7.2.2 Vandenberg AFB. The current regional and on-station safety programs described in Section 3.7.2 would remain in effect. Some vehicles would utilize solid rocket motors and would therefore produce an HCl toxic plume. However, Vandenberg AFB personnel and the general public are predicted not to be at risk during nominal or aborted launches. Under the

No-Action Alternative, no additional health and safety risks would be incurred beyond current operating levels.

4.8 GEOLOGY AND SOILS

4.8.1 Proposed Action

4.8.1.1 Concept A

4.8.1.1.1 Concept A, Cape Canaveral AS

Geologic Setting. EELV program activities would require modification of existing facilities and construction of new facilities at SLC-41, which has been extensively altered in the past. Major modifications would include changing the existing site topography through excavation and grading, as required, to support modifications to the transporter track system, and facility modifications and new construction. Construction of EELV facilities at SLC-41 would substantially alter the topography of the site beyond changes that result from natural erosion or deposition. Construction of these facilities would not change the physiography of the region, nor would it impact any unique geologic features or geologic features of unusual scientific value.

Soils. Construction would occur primarily within the previously disturbed SLC-41 site and along existing road corridors. Depending on final design and grading plans, approximately 24,000 cubic yards of cut and fill material would be required. Unsuitable cut material would be removed from the project area to a spoil site located off station or at other approved locations. The earthwork required to construct the launch facility would uncover and disturb soils and increase the potential for wind and water erosion of these exposed soils.

Appropriate measures to reduce wind and water erosion would be implemented. Grading and construction procedures would be designed to minimize topographic changes. The design would include balancing the amount of cut and fill to maximize the use of local material, where possible. Additional measures for erosion control may include temporary seeding (for areas of the site where disturbance has temporarily ceased), permanent seeding, mulching, sod stabilization, and vegetative buffer strips. Sediment and erosion controls can also include engineered structures to divert or store flow, or limit runoff. These devices include earth dikes that channel flow to desired locations; silt fences to intercept sediment; drainage swales; sediment traps; check dams; level spreaders; subsurface drains; and other structures used to control or direct surface discharge and limit/control erosion.

The Environmental Resources Permit and Storm Water Pollution Prevention Plan would include specific measures that would be implemented to control both wind and water erosion of soils before and during construction activities. Sediment and erosion controls generally address pollutants in storm water generated from the site during construction. Storm water management measures are generally implemented before and during construction and primarily result in reductions of pollutants in storm water. Storm water management measures include infiltration of runoff on site; flow attenuation by vegetation or natural depressions; outfall velocity dissipation devices;

storm water retention structures and artificial wetlands; and storm water detention structures. For many sites, a combination of these controls may be appropriate. Additional measures include best management practices.

Utilization of SLC-41 for the EELV program would have a beneficial impact upon soils. Currently, SLC-41 is used to launch Titan IVB rockets, which use solid rocket propellants. The ground cloud created by solid rocket propellant causes deposition of HCl and aluminum oxide on the soil adjacent to the launch site, resulting in temporary acidification and an increase of aluminum in soils. Concept A launch vehicles would only use liquid fuels, which would vaporize during launch, thus no deposition on the soil or temporary acidification would occur.

Launch anomalies could result in impacts to near-field soils due to contamination from rocket propellant. In the unlikely occurrence of a launch anomaly, any spilled propellant would be collected and disposed of by a certified disposal subcontractor in accordance with the SPCC Plan. Contaminated soils would be removed and treated as hazardous waste in accordance with federal, state, and local regulations. Short-term impacts to soils may result, but long-term impacts would not be significant.

Standard construction practices and adherence to permit requirements would minimize adverse impacts to geology and soils; therefore, no mitigation measures would be required.

4.8.1.1.2 Concept A, Vandenberg AFB

Geologic Setting. EELV program activities would require modification of existing facilities and construction of new facilities at SLC-3W, which has been extensively altered in the past. Construction of EELV facilities at SLC-3W would substantially alter the topography of the site beyond those changes that would result from natural erosion or deposition. Construction of these facilities would not change the physiography of the region, nor would it impact any unique geologic features or geologic features of unusual scientific value.

Geologic concerns in the Vandenberg AFB area are the potential effects of erosion and landslides, primarily related to cut and fill activities during project construction, and earthquakes that could occur during program operations.

The SLC-3W site is not in a potential landslide area or near sand dunes (U.S. Air Force, 1989a). The nearest active fault, the Hosgri Fault, 2.5 miles northwest of the site, is capable of causing sustained ground shaking and/or surface rupture. Construction of new facilities and/or modification of existing facilities would incorporate earthquake-resistant design as required by building codes to reduce the potential for impacts from a seismic event, including surface rupture. Site foundations would incorporate site-specific engineering designs appropriate to maintain structural integrity during extended periods of ground shaking.

Soils. Construction would occur primarily within the existing fenceline of the previously disturbed SLC-3W area. Depending on final design and grading plans, approximately 142,000 cubic yards of cut and fill material would be required. The fill material would most likely come from the Manzanita Borrow

Area on Vandenberg AFB. Unsuitable cut material would be returned to the embankment cut, which would be regraded prior to site revegetation. Some spoil material would be disposed of in the on-base landfill. The earthwork required for new construction would uncover and disturb soils and increase the potential for wind and water erosion of these exposed soils.

Appropriate measures to reduce wind and water erosion at the stock pile and construction sites would be implemented (see Section 4.8.1.1.1).

Launch anomaly impacts would be similar to those described in Section 4.8.1.1.1, under Soils.

Standard construction practices and adherence to permit requirements would minimize adverse impacts to geology and soils; therefore, no mitigation measures would be required.

4.8.1.2 Concept B

4.8.1.2.1 Concept B, Cape Canaveral AS

Geologic Setting. EELV program activities would require modification of existing facilities and construction of new facilities at SLC-37, which has been altered extensively in the past. Major modifications at the site would include changing the existing site topography through excavation and grading. Construction of EELV facilities at SLC-37 would substantially alter the topography of the site beyond those changes that would result from natural erosion or deposition. Construction of these facilities would not change the physiography of the region, nor would it impact any unique geologic features or geologic features of unusual scientific value.

Soils. Construction would occur primarily within the previously disturbed SLC-37 area or along existing road corridors. Depending on final design and grading plans, approximately 10,000 to 18,000 cubic yards of material would be excavated, and 220,000 to 360,000 cubic yards of fill would be required. Fill material would come from borrow areas located off station. Unsuitable cut material would be removed from the project area to a spoil site located on Cape Canaveral AS, or to other approved locations. The earthwork required to construct the launch facility would uncover and disturb soils and increase the potential for wind and water erosion of these exposed soils.

Appropriate measures to reduce wind and water erosion at the stock pile and construction sites would be implemented (see Section 4.8.1.1.1).

Launch anomaly impacts would be similar to those described in Section 4.8.1.1.1, under Soils.

For some small vehicle missions, a third stage containing solid propellant would be utilized. However, this stage would fire in orbit, and no acid deposition of solid propellants on soils would occur.

Under Concept B, only the commercial DIV-M+ launch vehicle would utilize solid rocket motors. A maximum of eight DIV-M+ commercial launches would occur per year under Concept B. Impacts from the use of solid rocket motors would result in the deposition of HCl from the exhaust cloud on the soil adjacent to the launch site, resulting in a temporary acidification of soils. The deposition of aluminum oxide particulates on soils adjacent to the launch site would also increase the concentration of aluminum in nearby soils.

The impact of multiple launches on the near-field soil could include a reduction in the capacity of the soil to buffer the temporary acidification observed following a launch and increased concentrations of metals. Impacts on far-field soils (over 0.6 mile from the launch site) are relatively insignificant because the deposition of particulates and chlorides is less than 3 percent of the maximum observed near the launch site (National Aeronautics and Space Administration, 1995).

The potential deposition of aluminum oxide per launch is expected to be minimal. Acidification impacts are temporary in nature, and results from monitoring of space shuttle launches show no long-term effects in the soils' buffering capacity (U.S. Air Force, 1994c). No measurable direct or indirect, short- or long-term effects on soil chemistry are expected as a result of Concept B launch activities.

The Port of Canaveral Dock would be utilized for receiving/unloading of EELV program components. This dock has recently been modified and would meet the requirements of the EELV program. However, if this dock were unavailable to the EELV program, the U.S. Air Force Roll-On/Roll-Off Dock would be utilized. This dock would require limited dredging to accommodate the turning radius of the transport vehicle/dolly in the egress area. Dredging would occur in previously dredged areas only, thus eliminating impacts to undisturbed sediments.

Standard construction practices and adherence to permit requirements would minimize adverse impacts to geology and soils; therefore, no mitigation measures would be required.

4.8.1.2.2 Concept B, Vandenberg AFB

Geologic Setting. EELV program activities would require modification of existing facilities and construction of new facilities at SLC-6, which has been altered extensively in the past. Major modifications would include changing the existing site topography through excavation and grading. Construction of EELV facilities at SLC-6 would substantially alter the topography of the site beyond those changes that would result from natural erosion or deposition. Construction of these facilities would not change the physiography of the region, nor would it impact any unique geologic features or geologic features of unusual scientific value.

Geologic concerns in the Vandenberg AFB area are the potential effects of erosion and landslides, primarily related to cut and fill activities during project construction, and earthquakes that could occur during program operations.

The nearest active fault, the Hosgri Fault, 7.5 miles northwest of the site, is capable of causing sustained ground shaking and/or surface rupture. Construction of new facilities or modification of existing facilities would incorporate earthquake-resistant design as required by building codes to reduce the potential of significant impacts occurring from a seismic event, including surface rupture. Site foundations would incorporate site-specific engineering designs appropriate to maintain structural integrity during extended periods of ground shaking.

The SLC-6 site is not located near sand dunes, but it is in a potential landslide area (U.S. Air Force, 1989a). SLC-6 is approximately 1.5 miles from the coast; therefore, it is unlikely that the site would be subject to slope failures of the sea cliff. The site has experienced previous erosion near the drainages bounding the site. This erosion problem has subsequently been stabilized. The SLC-6 launch complex has not experienced landsliding in the past.

Soils. SLC-6 is underlain by soils that have a high erosion potential. An erosion control program, conducted as part of site maintenance activities for SLC-6, has stabilized most slopes so that erosion has been minimized.

Construction would occur primarily within the previously disturbed SLC-6 area or along existing road corridors. Depending on final design and grading plans, approximately 4,500 to 7,500 cubic yards of material would be excavated and 80,000 to 135,000 cubic yards of fill material would be required at SLC-6. Fill material would most likely come from the Vandenberg AFB Manzanita Borrow Area. Unsuitable cut material would be removed from the project area to the Manzanita Spoil Site, or to other approved locations. Topsoil would be removed and stockpiled on site for re-spreading on disturbed areas for revegetation and erosion control after completion of construction. The earthwork required to construct the launch facility would uncover and disturb soils and increase the potential for wind and water erosion of these exposed soils.

Appropriate measures to reduce wind and water erosion at the stock pile and construction sites would be implemented (see Section 4.8.1.1.1).

Launch anomaly impacts would be similar to those described in Section 4.8.1.1.1, under Soils.

For some small-vehicle missions, under Concept B, a third stage containing solid propellant would be utilized. However, this stage would fire in orbit and no deposition of solid propellants on soils would occur.

Under Concept B, only the commercial DIV-M+ launch vehicle would utilize solid rocket motors. A maximum of four DIV-M+ commercial launches would occur per year under Concept B. Impacts from the use of solid rocket propellants are described in Section 4.8.1.2.1, under Soils.

The South Vandenberg AFB boat dock area would be utilized for receiving/unloading of EELV components. The harbor channel would be dredged to the level of its prior dredging depth, thus eliminating impacts to undisturbed sediments. Approximately 20,000 cubic yards of sediment would be dredged; dredged material would be disposed of in accordance with USACE permit requirements.

Standard construction practices and adherence to permit requirements would minimize adverse impacts to geology and soils; therefore, no mitigation measures would be required.

4.8.1.3 Concept A/B

4.8.1.3.1 Concept A/B, Cape Canaveral AS

Geologic Setting. Under Concept A/B, both SLC-41 and SLC-37 would be utilized for EELV activities. Impacts to physiography and geology for these sites would be similar to the combined effects discussed for Concepts A and B in Sections 4.8.1.1.1 and 4.8.1.2.1, under Geologic Setting.

Soils. Under Concept A/B, both SLC-41 and SLC-37 would be utilized. Impacts to soils at these sites would be similar to the combined effects discussed for Concepts A and B in Sections 4.8.1.1.1 and 4.8.1.2.1, under Soils.

As discussed in Sections 4.8.1.1.1 and 4.8.1.2.1, standard construction practices and adherence to permit requirements would minimize adverse impacts to geology and soils. Therefore, no impacts are anticipated, and no mitigation measures would be required.

4.8.1.3.2 Concept A/B, Vandenberg AFB

Geologic Setting. Under Concept A/B, both SLC-3W and SLC-6 would be utilized. Impacts to physiography and geology at these sites would be similar to the combined effects discussed for Concepts A and B in Sections 4.8.1.1.2 and 4.8.1.2.2, under Geologic Setting.

Soils. Under Concept A/B, both SLC-3W and SLC-6 would be utilized. Impacts to soils for these sites are discussed under Sections 4.8.1.1.2 and 4.8.1.2.2, under Soils.

As discussed in Sections 4.8.1.1.2 and 4.8.1.2.2, standard construction practices and adherence to permit requirements would minimize adverse impacts to geology and soils. Therefore, no impacts are anticipated, and no mitigation measures would be required.

4.8.2 No-Action Alternative

4.8.2.1 Cape Canaveral AS

Under the No-Action Alternative, no new construction or facility modification would occur. A maximum of 11 launches per year would take place. Since existing programs utilize solid rocket propellant, the potential impact to soils is greater than that of either Concept A (only liquid fuels) or B (smaller amount of launches utilizing solid rocket propellant) of the EELV program. However, impacts to soils are temporary and minimal, as described in Section 4.8.1.2.1, under Soils. No adverse impacts to geology or soils are expected from continuation of existing launch programs.

4.8.2.2 Vandenberg AFB

A maximum of six launches per year would occur under this concept. Some of these launches would use solid rocket propellant. Impacts from the No-Action Alternative at Vandenberg AFB would be similar to the impacts described in Section 4.8.2.1, Cape Canaveral AS.

4.9 WATER RESOURCES

Impacts to water resources could result from any of the following project-related effects:

- Degradation of surface or groundwater quality such that existing use would be impaired
- Interference with natural drainage patterns
- A shortage in the water supply system
- Development within a 100-year floodplain.

Potential impacts to wetlands are discussed under Section 4.14, Biological Resources.

4.9.1 Proposed Action

4.9.1.1 Concept A

4.9.1.1.1 Concept A, Cape Canaveral AS

Groundwater. The majority of water used for Concept A would be deluge water (50,000 gallons per launch) and acoustic suppression water (3,000 to 9,000 gallons per launch) for a maximum of 59,000 gallons per launch. Smaller amounts of water would be utilized for launch complex washdown, fire suppressant, and potable uses. During the peak launch year (2015), Concept A launch activities (6 launches) would require approximately 1,357,000 gallons of water.

The city of Cocoa, which pumps water from the Floridan aquifer, is contracted to supply 6,500,000 gpd of water per day to Cape Canaveral AS and Patrick AFB. Maximum water use at Cape Canaveral AS and Patrick AFB is 1,000,000 and 3,800,000 gpd, respectively, which includes water to support current launch programs (45 Space Wing, 1995). On the day of a launch, Concept A would require approximately 3.5 percent of the excess available water. Based on this small, incremental increase of water use per launch, Concept A would not noticeably affect the quantity of water available to Cape Canaveral AS or the surrounding area or increase the amount of water withdrawn from the Floridan aquifer on a daily basis. With the discontinuation of the current systems, water demand would be reduced. According to the general plan for Cape Canaveral AS, the city of Cocoa has sufficient adequacy and reliability of supply sources to meet usage demands and water quality standards (45 Space Wing, 1995). Therefore, adverse impacts to groundwater resources are not expected, and no mitigation measures would be required.

Surface Water. Grading around SLC-41 for the proposed EELV program would alter the existing surface drainage patterns at the site through excavation, grading, and the creation of impervious surfaces. This site has been previously disturbed, so natural drainage patterns no longer exist. Design of the proposed project would not substantially alter the existing drainage course. Therefore, adverse impacts to natural drainages are not anticipated.

Portions of the area for construction of the two proposed assembly facilities south of SLC-41 lie within the 100-year floodplain. Construction of these facilities could result in impacts associated with modification of the floodplain. Although construction and operation of these facilities would take place in a floodplain, they would not noticeably increase the potential for floods. Although these structures would be built within the 100-year floodplain, no adverse environmental impacts to water quantity or quality are expected. The Air Force will prepare a FONPA in compliance with requirements established in EO 11988. The FONPA must be signed by SAF/MIQ prior to initiation of construction activities that could affect floodplains.

Impacts from erosion, and specific measures to control both wind and water erosion of soils during and after construction, are addressed in Section 4.8.1.1.1, under Geology and Soils.

Since the construction area for the EELV program is greater than 5 acres, an NPDES permit for storm water discharge associated with construction activity would also be required. The objectives of this permit are to: (1) identify pollutant sources that may affect the quality of discharges of storm water associated with construction activities; and (2) identify, construct, and implement storm water pollution preventive measures and best management practices to reduce pollutants in storm water discharges from the construction site both during and after construction. This permit would require implementation of storm water control measures to reduce potential impacts to surface water.

Standard construction practices and adherence to permit requirements and applicable regulations would minimize adverse impacts to water resources; therefore, no mitigation measures would be required.

Water Quality. Water quality in the area of SLC-41 could be affected as a result of contamination of surface waters by the launch exhaust cloud. However, Concept A launches would utilize liquid propellants only, which would result in fewer impacts to water quality than the current launch vehicle systems that utilize solid rocket propellant. Liquid propellant is rapidly combusted during a launch and almost completely burned. Therefore, very little propellant would be deposited on the launch pad or in the surrounding area. Adverse impacts to surface water and groundwater quality resulting from the exhaust cloud are not expected.

Launches would require use of deluge and acoustic suppression water. Approximately 10,000 of the 59,000 gallons of deluge and acoustic suppression water used per launch would be vaporized, or percolate into the soil, during launch. Residual deluge water generated during vehicle launches is a potential source of contamination to adjacent surface waters and groundwater. However, deluge water would be retained in the flame duct after launches, tested for water quality characteristics, and released to grade in accordance with the FDEP Industrial Wastewater Discharge permit requirements. Deluge water would be released at a controlled rate to ensure that water percolates into the ground. If contaminant concentrations in the treated deluge water are too high, and the water cannot be released to grade, it would be released to the WWTP. Wastewater would be disposed of in accordance with applicable federal, state, and local regulations. Storm water runoff prior to washdown would be contained to avoid the potential for impacts to surface water resources. Storm water runoff would be tested and treated, if necessary, prior to release. Soils in the vicinity of SLC-41 have a very rapid permeability rate and should be able to handle all water releases associated with launches at this site. Adverse impacts to surface water and groundwater quality resulting from deluge and storm water runoff are not anticipated.

Under normal flight conditions, vehicle stages that do not reach orbit have trajectories that result in ocean impact. Stages that reach initial orbit would eventually re-enter the atmosphere as a result of orbital decay. Corrosion of stage hardware would contribute various metal ions to the water column. Due to the slow rate of corrosion in the deep-ocean environment and the large quantity of water available for dilution, toxic concentrations of metals are not likely to occur. Relatively small amounts of propellant would also be released into the ocean along with the various spent stages. Because of the limited number of launch events scheduled, the small amount of residual propellants present, and the large volume of water available for dilution, no adverse impacts are expected from the re-entry of spent stages.

On-pad accidental or emergency releases of small quantities of propellants are unlikely to occur. However, if there is a release, spilled propellants would be collected and disposed of by a certified disposal subcontractor in accordance with the SPCC plan. Potential contamination of groundwater and/or surface water resulting from accidental or emergency spills of propellants during fueling would be minimized through adherence to strict safety procedures. Potential leakage or spills from propellant storage tanks would be contained in holding basins that surround the tanks. Any accidental or emergency release of propellants after fueling would be collected in the flume located directly beneath the launch vehicle and channeled to an impermeable concrete catch basin. Contaminants collected in the catch basin would be disposed of in accordance with appropriate state and federal regulations. No discharges of contaminated water are expected to result from EELV operations at SLC-41, and no adverse impacts to water quality are anticipated.

Launch anomalies could result in impacts to local water bodies due to contamination from rocket propellant. In the unlikely occurrence of a launch anomaly, spilled propellant could enter water bodies close to the launch pad. At Cape Canaveral AS, they could enter the Atlantic Ocean or the Banana

River. Short-term impacts to the near-shore environments may result, but long-term impacts would not be significant due to the buffering capacity of the Atlantic Ocean and Banana River.

Adherence to permit requirements and applicable regulations would minimize adverse impacts to water quality; therefore, no mitigation measures would be necessary.

4.9.1.1.2 Concept A, Vandenberg AFB

Groundwater. Until recently, the potable water supply for Vandenberg AFB was obtained solely from groundwater sources. These sources had been affected by a severe overdraft. Vandenberg AFB now receives supplemental potable water from the State Water Project, which does not draw from aquifers in the area. This will relieve the overdraft situation and allow the aquifer to eventually recharge. EELV program activities are not expected to affect groundwater resources, and no mitigation measures would be required.

Surface Water. Vandenberg AFB can purchase up to 1.46 billion gallons of water per year from the State Water Project. In the peak launch year (2007), there would be 6 EELV launches, each using approximately 59,000 gallons of deluge water, or approximately 1.5 percent of the available water per day for each launch. Based on this small, incremental amount of water use per launch, Concept A activities would not noticeably affect the quantity of water available to Vandenberg AFB or the surrounding area.

Grading for new construction around SLC-3W would alter the existing surface drainage patterns at the site through excavation, grading, and the creation of impervious surfaces. This site has been previously disturbed, so natural drainage patterns no longer exist. Design of the new facilities would not substantially alter the existing drainage courses. Therefore, adverse impacts to natural drainages are not anticipated. Impacts from erosion are addressed in Section 4.8, under Soils and Geology.

Because the construction area for the EELV program is greater than 5 acres, a NPDES permit for storm water discharge associated with construction activity would be required (see Section 4.9.1.1.1, under Surface Water). This permit would require implementation of storm water control measures to prevent impacts to surface water.

Standard construction practices and adherence to permit requirements and regulations would minimize adverse impacts to water resources; therefore, no mitigation measures would be required.

Water Quality. Water quality in the area of SLC-3W could be affected as a result of contamination of surface waters by the exhaust cloud. As described in Section 4.9.1.1.1, under Water Quality, Concept A launches would use only liquid propellant, which would result in fewer impacts to water quality than the current launch vehicles, which utilize solid rocket propellant. Adverse impacts to surface water and groundwater quality resulting from the exhaust cloud are not expected.

Launches would require use of deluge and acoustic suppression water. Approximately 10,000 of the 59,000 gallons of deluge water used per launch would be vaporized, or percolate into the soil, during launch. Residual deluge water generated during vehicle launches is a potential source of contamination to adjacent surface waters and groundwater; however, no direct discharge is expected to occur during launches from SLC-3W. After a launch, the launch pad would be washed down. Deluge and washdown water would be collected, tested, and treated, if necessary, prior to disposal as industrial wastewater at the SLC-6 treatment plant. If the water is classified as hazardous, it would be containerized and disposed of properly. Storm water runoff prior to washdown would be contained and tested, prior to disposal at the SLC-6 treatment plant, to avoid the potential for impacts to surface water resources. Adverse impacts to surface water and groundwater resulting from deluge or storm water runoff are not anticipated.

Potential impacts from vehicle stages that do not reach orbit, on-pad accidental or emergency releases of propellants, and launch anomalies are discussed in Section 4.9.1.1.1, under Water Quality. No adverse impacts are anticipated.

Adherence to permit requirements and regulations would minimize adverse impacts to water quality; therefore, no mitigation measures would be required.

4.9.1.2 Concept B

4.9.1.2.1 Concept B, Cape Canaveral AS

Groundwater. Concept B launches may not require the use of deluge water. However, a maximum of 200,000 to 300,000 gallons of water may be sprayed into the flame deflector to cool the rocket exhaust and minimize damage to the launch pad. The majority of water use for Concept B would occur during a launch. If water were used for every launch during the peak year (23 launches), Concept B activities would require approximately 6,900,000 gallons of water for that year.

As stated in Section 4.9.1.1.1, Groundwater, the city of Cocoa is contracted to supply 6,500,000 gpd to Cape Canaveral AS and Patrick AFB. This quantity includes water to support current launch programs. During Concept B launches, approximately 17.6 percent of the excess available water that day would be required. Based on this increase of water use per launch, it is assumed that Concept B would not significantly affect the quantity of water available to Cape Canaveral AS or the surrounding area or noticeably increase the amount of water withdrawn from the Floridan aquifer on a daily basis. With the discontinuation of current launch vehicle operations, water demand would be reduced. According to the general plan, the City of Cocoa has sufficient adequacy and reliability of supply sources to meet usage demands and water quality standards (45 Space Wing, 1995). Therefore, adverse impacts to groundwater are not expected, and mitigation measures would not be required.

Surface Water. Grading around SLC-37 would alter the existing surface drainage patterns at the site through excavation, grading, and the creation of impervious surfaces. This site has been previously disturbed, so natural drainage patterns no longer exist. Design of the proposed facilities would not substantially alter the existing drainage course. Therefore, adverse impacts to natural drainages are not anticipated. Impacts from erosion are addressed in Section 4.8, under Soils and Geology.

Since the construction area for the EELV program is greater than 5 acres, an NPDES permit for storm water discharge associated with construction activity is required (see Section 4.9.1.1.1, under Surface Water). This permit would require implementation of storm water control measures to prevent impacts to surface water.

The discharge of dredged or fill material into, or the excavation of soils from, Waters of the United States, which include special aquatic sites such as wetlands, is regulated under Section 404 of the CWA (U.S. Environmental Protection Agency, 1987). Construction for Concept B would require a permit under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act of 1899 from the USACE. Section 404 requires that measures be taken to: (1) avoid and (2) minimize impacts to Waters of the United States. In the 404 permit, a mitigation monitoring plan would be developed in coordination with appropriate resource agencies, and a final plan would be approved by the USACE. Given compliance with 404 permit regulations, no adverse impacts to water resources are expected.

Standard construction practices and adherence to permit requirements and applicable regulations would minimize impacts to water resources; therefore, no mitigation measures would be required.

Water Quality. Launches may require the use of up to 300,000 gallons of deluge water. Residual water is a potential source of contamination to adjacent surface waters and groundwater; however, no direct discharge is expected to occur during launches from SLC-37. Deluge water would be retained in the flame duct after launches, tested for water quality characteristics, and released to grade in accordance with the FDEP Industrial Wastewater Discharge permit requirements. Deluge water would be released at a controlled rate to ensure that water percolates into the ground. If concentrations of contaminants in the treated deluge water are too high, and water cannot be released to grade, it would be released to the WWTP. Wastewater would be disposed of in accordance with applicable federal, state, and local requirements. Storm water runoff prior to washdown would be contained to avoid the potential for impacts to surface water resources. Storm water runoff would be tested and treated, if necessary, prior to release. Soils in the vicinity of SLC-37 have a very rapid permeability rate and should be able to handle all water releases associated with launches at this site. Adverse impacts to surface water and groundwater resulting from deluge or storm water runoff are not anticipated.

Potential impacts from vehicle stages that do not reach orbit, on-pad accidental and emergency releases of propellant, and launch anomalies are discussed in Section 4.9.1.1.1, under Water Quality. No adverse impacts are anticipated.

For some small vehicle missions, a third stage containing solid propellant would be utilized. However, this stage would ignite in orbit, and no deposition of propellant on surface waters would occur. Therefore, no adverse impacts to water quality are anticipated.

Water quality in the area of SLC-37 could be affected as a result of contamination of surface waters by the exhaust cloud. Under Concept B activities, only the commercial DIV-M+ launch vehicle would utilize solid rocket motors. A maximum of 8 DIV-M+ launches would occur in one year. During a launch, the solid propellant is released in the exhaust ground cloud produced by vehicle launch and surface water. The effect of the ground cloud on water quality would be a function of the exhaust cloud composition, distance to surface water, duration of its contact with the water, wind speed and direction, and other atmospheric conditions. The exhaust ground cloud would consist primarily of HCl, Al_2O_3, and CO_2. The primary concern associated with the ground cloud impacts on water quality is the formation of large quantities of HCl, much of which would stay aloft and disperse over a large area in the atmosphere. Depending on the wind direction, most of the exhaust could drift over the Banana River or the Atlantic Ocean, which may result in a brief acidification of surface waters from HCl. The large volume and buffering capacities of the Atlantic Ocean and Banana River would neutralize any acidification that may occur as a result of HCl deposition. Aluminum oxide is relatively insoluble because of the pH of local surface waters and is not expected to cause elevated aluminum levels. Therefore, no adverse impacts to surface water are expected from the use of the solid rocket motors, and no mitigation measures would be required.

Exhaust cloud deposits and propellant residues remain on the pad and are deposited in near-field soils after a launch. These residues would be washed from the pad during post-launch washdown or by storm water, which would be retained in catch basins. This water would then be analyzed and discharged to percolation ponds if it meets regulatory requirements. If contaminant concentrations are too high and the water cannot be released to grade, it would be released to the WWTP. Wastewater would be disposed of in accordance with applicable federal, state, and local regulations. Thus, Concept B launches would not adversely affect groundwater quality in the surficial aquifer.

Launch anomalies could result in impacts to local water bodies due to contamination from rocket propellant. In the unlikely occurrence of a launch anomaly, spilled propellant could enter water bodies close to the launch pad. At Cape Canaveral AS, propellant could enter the Atlantic Ocean or the Banana River. Potential contamination would primarily occur from solid rocket motor propellant. Solid propellant would cause contamination in the form of acidification from HCl and the deposition of aluminum oxide. Recovered solids would be removed from near-shore ocean and/or river environments and treated as hazardous waste in accordance with federal, state, and local regulations. Short-term impacts to the near-shore environments may result, but long-term impacts would not be significant due to the buffering capacity of the Atlantic Ocean and Banana River.

Adherence to permit requirements and applicable regulations would minimize adverse impacts to water quality; therefore, no mitigation measures would be required.

4.9.1.2.2 Concept B, Vandenberg AFB

Groundwater. Water required to support EELV programs would be supplied from the State Water Project and not from local wells in the area. No adverse impacts to groundwater resources are anticipated, and no mitigation measures would be required.

Surface Water. As discussed in Section 4.9.2.1.2, Concept B launches are not expected to utilize deluge water. However, a maximum of 200,000 to 300,000 gallons of water may be used to cool the rocket exhaust and minimize damage to the launch pad. During the peak year, there would be 6 launches each, using up to 300,000 gallons of water. These activities would require approximately 7.5 percent of the available water per day for each launch. Based on the small, incremental amount of water use per launch, Concept B activities would not noticeably affect the quantity of water available to Vandenberg AFB or the surrounding area.

Surface water around SLC-6 drains through erosion control ditches into a small arroyo located on the north side of SLC-6. Grading would alter the existing surface drainage patterns at the site through excavation, grading, and the creation of impervious surfaces. This site has been previously disturbed, so natural drainage patterns no longer exist. Design of the proposed facilities would not substantially alter the existing drainage courses on the site. Therefore, adverse impacts to natural drainages are not anticipated. Impacts from erosion are addressed in Section 4.8, under Geology and Soils.

Since the construction area for the EELV program is greater than 5 acres, an NPDES permit for storm water discharge associated with construction activity would be required (see Section 4.9.1.1.1, under Surface Water). This permit would require implementation of storm water control measures to prevent impacts to surface water.

Impacts related to dredging are addressed in Section 4.9.1.2.1, under Surface Water. This discussion includes mitigation measures to prevent impacts.

Standard construction practices and adherence to permit requirements and applicable regulations would minimize adverse impacts to water resources; therefore, no mitigation measures would be required.

Water Quality. Launches may require the use of approximately 300,000 gallons of deluge water. Residual water is a potential source of contamination to adjacent surface waters and groundwater; however, no direct discharge is expected to occur during launches from SLC-6. During a launch, the launch pad may be sprayed with deluge water. After launch of the EELV, the launch pad would be washed down. This water would be collected, tested, and treated, if necessary, prior to disposal as industrial wastewater at the SLC-6 treatment plant. If the water is classified as hazardous, it would be containerized and disposed of properly. Storm water runoff prior to washdown would be contained and tested, prior to disposal at the SLC-6 treatment plant, to avoid the potential for impacts to surface water resources. Adverse impacts to surface water or groundwater resulting from deluge or storm water runoff are not anticipated.

Potential impacts from vehicle stages that do not reach orbit, on-pad accidental or emergency releases, and launch anomalies are discussed in under Section 4.9.1.1.1, Water Quality. No adverse impacts are anticipated.

For some small-vehicle missions under Concept B, a third stage containing solid propellant would be utilized. However, this stage would ignite in orbit, and no deposition of propellant on surface waters would occur. Therefore, no adverse impacts to water quality are anticipated.

Water quality in the area of SLC-6 could be affected as a result of contamination of surface waters by the exhaust cloud. Under Concept B activities, only the commercial DIV-M+ launch vehicle would utilize solid rocket motors. A maximum of four DIV-M+ commercial launches is proposed for one year. Impacts would be the same as described in Section 4.9.1.1.1, under Water Quality.

In studies conducted at SLC-2W, some trace metals were identified in surface soils near the pad. The amounts were so small that it was hard to determine whether they were background metals or were derived from launch activities. Based on the lack of substantial accumulation of metals and other surface contaminants at the site, it was assumed that they are neither deposited in appreciable amounts nor accumulate over time. In addition, the lack of high concentrations of metals downgradient of the pad suggests no long-term accumulation of such contaminants off site (ENSR Corporation, 1996). Based on these findings, aluminum oxide deposits are not expected to cause elevated aluminum levels in nearby soils or water bodies. Therefore, adverse water quality impacts to surface water are not expected.

Exhaust cloud deposits and propellant residues remain on the pad and are deposited in near-field soils after a launch. These residues would be washed from the pad by a post-launch washdown or by storm water, which would be retained in catch basins. This water would then be analyzed and treated prior to disposal as industrial wastewater at the SLC-6 treatment plant. Concept B wastewater and storm water would not be allowed to percolate into the local groundwater. Therefore, no adverse impacts to groundwater are anticipated.

Adherence to permit requirements and applicable regulations would minimize adverse impacts to water quality; therefore, no mitigation measures would be required.

4.9.2 Concept A/B

4.9.2.1 Concept A/B, Cape Canaveral AS

Groundwater. Impacts to groundwater would be similar to the combined effects for Concepts A and B discussed in Sections 4.9.1.1.1 and 4.9.1.2.1. A maximum of 4,667,000 gallons of water per year would be required to support launches during the peak year. However, impacts would be similar to those described for Concept B in Section 4.9.1.2.1, under Groundwater, because the maximum water use per launch would be 300,000 gallons. Concept A/B launches would use a maximum of 17.6 percent of the excess water available on the day of the launch. Based on this increase of water use during a launch, Concept A/B launches would not noticeably affect the quantity of water available to Cape Canaveral AS or the surrounding area, or increase the amount of water withdrawn from the aquifer on a daily basis. With the discontinuation of current launch vehicle operations, water demand would be reduced. Therefore, adverse impacts to groundwater are not anticipated, and mitigation measures would not be required.

Surface Water. Impacts to surface water would be similar to those discussed in Sections 4.9.1.1.1 and 4.9.1.2.1, under Surface Water. No adverse impacts are anticipated.

As discussed in Sections 4.9.1.1.1 and 4.9.1.2.1, under Surface Water, standard construction practices and adherence to permit requirements and applicable regulations would minimize adverse impacts to water resources; therefore, no mitigation measures would be required.

Water Quality. Impacts to water quality would be similar to those discussed in Sections 4.9.1.1.1 and 4.9.1.2.1, under Water Quality. No adverse impacts to groundwater or surface water quality are anticipated; therefore, no mitigation measures would be required.

4.9.2.2 Concept A/B, Vandenberg AFB

Groundwater. As described in Section 4.9.1.1.2, under Groundwater, water required to support EELV programs would be supplemented by the State Water Project. No adverse impacts to groundwater resources are anticipated from Concept A/B activities, and no mitigation measures would be required.

Surface Water. Concept A/B activities would require use of up to 2,513,000 gallons of water during the peak year. However, impacts would be similar to those described in Section 4.9.1.2.2, under Surface Water, because the maximum water use per launch would be 300,000 gallons. Concept A/B launches would use a maximum of up to 7.5 percent of the water available on the day of the launch. Based on the small, incremental amount of water use per launch, Concept A/B launches would not noticeably affect the quantity of water available to Vandenberg AFB or the surrounding area. Existing water use includes current launch vehicles, so impacts to water use would likely be less than anticipated. Impacts to surface water would be similar to those discussed in Sections 4.9.1.1.2 and 4.9.1.2.2, Surface Water.

As discussed under Sections 4.9.1.1.2 and 4.9.1.2.2, Surface Waters, standard construction practices and adherence to permit requirements and applicable regulations would minimize adverse impacts to water resources; therefore, no mitigation measures would be required.

Water Quality. Impacts to water quality would be similar to those discussed in Sections 4.9.1.1.2 and 4.9.1.2.2, Water Quality. No adverse impacts to groundwater or surface water quality are anticipated; therefore, no mitigation measures would be required.

4.9.3 No-Action Alternative

4.9.3.1 Cape Canaveral AS

Groundwater. Under the No-Action Alternative, a maximum of approximately 1,730,000 gallons of deluge water would be required to support 11 launches. The Atlas IIA launch vehicle uses a maximum of 200,000 gallons of water per launch. Therefore, Atlas IIA would require 11.8 percent of the excess water available on the day of a launch. The No-Action Alternative would not significantly affect the quantity of water available to Cape Canaveral AS or the surrounding area or increase the amount of water withdrawn from the Floridan aquifer on a daily basis. Impacts to groundwater are not anticipated, and mitigation measures would not be required.

Surface Water. Adverse impacts to surface water are not anticipated since no construction or modification of facilities is planned; therefore, no mitigation measures would be required.

Water Quality. The existing launch vehicles use solid rocket propellant, so impacts from the No-Action Alternative would be similar to those described under Section 4.9.1.2.1, Water Quality. Adverse impacts to surface and groundwater quality are not anticipated; therefore, no mitigation measures would be required.

4.9.3.2 Vandenberg AFB

Groundwater. As stated in Section 4.9.1.1.2, Groundwater, Vandenberg AFB has sufficient water to support No-Action Alternative launches. No adverse impacts to groundwater resources are expected, and no mitigation measures would be required.

Surface Water. Under the No-Action Alternative, a maximum of 920,000 gallons of water would be required to support 6 launches. The Atlas IIA launch vehicle uses a maximum of 200,000 gallons of water per launch. Therefore, Atlas IIA would require 5 percent of the water available on the day of a launch. The No-Action Alternative would not significantly affect the quantity of water available to Vandenberg AFB or the surrounding area. Adverse impacts to surface water are not anticipated; therefore, no mitigation measures would be required.

Water Quality. Some of the existing launch vehicles use solid rocket propellant, so impacts from the No-Action Alternative would be similar to those described under Section 4.9.1.2.2, under Water Quality. Adverse impacts to surface and groundwater quality are not anticipated; therefore, no mitigation measures would be required.

4.10 AIR QUALITY (LOWER ATMOSPHERE)

4.10.1 Proposed Action

Air quality impacts could occur during facility construction, pre- and post-launch processing operations, and from vehicle launch. Effects from vehicle launch on the lower atmosphere are addressed in this section; effects from vehicle launch on the upper atmosphere are addressed in Section 4.11.

Construction-related impacts could result from construction equipment (exhaust emissions) and construction activities (fugitive dust emissions) over an intermittent period of about two years (beginning as early as 1998 and ending as late as 2002).

Operational impacts could occur from: (1) mobile sources such as support vehicles, commercial transport vehicles, and personal vehicles; (2) point sources such as heating/power plants, generators, storage tanks, and flares; (3) processes such as solvent cleaning, coating, and post-launch pad cleanup; and (4) vehicle launch.

Construction activities include renovation of existing structures and roads, construction of new facilities, and demolition of existing facilities. Analysis of construction emission sources includes estimating the amount of uncontrolled fugitive dust that would be emitted from disturbed surface areas and gaseous emissions from construction equipment and construction workers' vehicles.

Transportation emissions were calculated based on expected deliveries, support vehicle operation, and personal vehicle traffic. Results were compared to existing mobile source emissions.

No new major point sources are necessary to support the EELV program. Emission sources that would be required are typical of light industrial activities already occurring at Cape Canaveral AS and Vandenberg AFB (e.g., power generators, utility boilers, shop activities, painting and surface coating operations, solvent degreasing, vehicle assembly, fuels storage). Emissions were calculated for these activities and compared to existing conditions.

Launch emissions were modeled to determine their impact on the ambient air quality concentrations in the lower troposphere. This modeling was conducted using the REEDM air quality dispersion model (Brady et al., 1997). The REEDM model predicts the incremental increases in the concentrations of criteria and toxic pollutants. These increases were compared with federal and state ambient air quality standards. The following sections describe additional emission models used for each location.

Several launches, each with its associated support activities, would occur each year. The criteria pollutant emissions were totaled for the peak launch year, and this total was compared with regional annual air emissions and regulatory thresholds.

The health effects of air pollution differ among pollutants, which are sometimes referred to as contaminants of concern. SO_2, NO_x, and PM_{10} are respiratory irritants. Particulate matter may also interfere with oxygen exchange within the human respiratory system as a result of deposition of respirable particles in the lungs. CO decreases the ability of the blood to carry oxygen. VOCs include several different compounds that may have varying health effects. HAPs are specific VOCs and particulates posing acute or chronic health hazards. HAPs associated with pre-launch and post-launch processing include organic HAPs from solvent and coating use and hydrazine from vehicle fueling. Organic HAPs have compound-specific health hazards, such as irritation of the eyes, nose, and throat; dizziness; headaches; and nausea. Chronic (long-term) exposure can cause damage to internal organs; some organic HAPs are suspected carcinogens. Hydrazine can irritate eyes, nose, throat, and skin, and is a suspect carcinogen. Caustic or acidic pollutants, such as NH_3 or HCl, can also irritate mucus membranes.

In addition to causing direct health effects, VOCs and NO_x participate in photochemical reactions to cause ground-level ozone (smog), a respiratory irritant.

4.10.1.1 Concept A

4.10.1.1.1 Concept A - Cape Canaveral AS. Potential air quality impacts from Concept A operations could result from the general sources described in Section 4.10.1. Vehicle components would be delivered by truck and airplane; emissions from both forms of delivery have been calculated and compared to existing mobile source emissions. Fuels used in the Concept A vehicles would include kerosene fuel (RP-1), cryogenic gases (LO_2 and LH_2), hydrazines (MMH and N_2H_4), N_2O_4, and a small amount of PG-2. Emissions from the handling and storage of these fuels have been calculated and compared to existing emissions.

Facility Construction

Emissions generated by facility construction activities would be in the form of either gaseous or particulate pollutant emissions. Gaseous emissions would occur from heavy-duty construction equipment and vehicle travel to and from the site by construction workers. Emissions would consist primarily of combustion products. Particulate matter in the form of dust emissions would also be generated during the construction phase from excavation, earth moving, construction of buildings, and traffic on unpaved surface areas.

Facility construction for Concept A at Cape Canaveral AS would involve extensive renovation and some new construction at SLC-41. The disturbed area would total 9.6 acres (net of buildings), including 5.6 acres of the SLC-41 site and the 4 acres south of the site associated with construction of the assembly facilities and transporter rail. All calculations were made on the basis of average emissions per year over the construction period.

New and renovated structures within the disturbed acreage would include four support operations buildings and five gas or propellant storage/handling facilities. Additional buildings on station, but remote from the launch site, have also been scheduled for renovations and were included in all calculations. Square footage of all individual structures has been estimated from scale site plan drawings considering facilities with similar purposes at other military properties. Total new building floor space would be approximately 369,800 square feet. The surface area associated with paving modifications includes the sum of a factor for new pavement related to new building construction, plus all pavement that would be renovated for road and utility improvements. Sources for construction factors include The R. S. Means Building Construction Cost Data Index (1997) and actual ratios from at other government facilities (see Appendix J). Construction-related emissions for Concept A activities are provided in Table 4.10-1.

Local concentrations of criteria pollutants would increase during the construction phase. The PM_{10} emissions during the construction period would cause slightly elevated levels of PM_{10} in the immediate vicinity of the work site. However, particulate matter concentrations would fall off rapidly with distance from the construction site; the distance of particulate fallout would depend on the wind speed at the time. Further, these increased concentrations would occur only temporarily, during construction, and would decrease again after construction is completed.

Table 4.10-1. Construction-Related Emissions - Concept A, Cape Canaveral AS Average Annual Emissions Over Construction Period

	VOC	NO_x	CO	SO_2	PM_{10}
Grading Equipment (lbs/day):	1.2	7.7	1.7	0.5	1.3
Asphalt Paving (lbs/day):	0.0	0.0	0.0	0.0	0.0
Stationary Equipment (lbs/day):	31.7	25.9	5.6	1.7	1.5
Mobile Equipment (lbs/day):	30.2	301.0	306.1	17.2	22.7
Architectural Coatings (lbs/day):	35.4	0.0	0.0	0.0	0.0
Total Emissions (lbs/day):	99.0	337.6	313.4	19.4	25.5
Total Emissions (tpy):	11.4	38.8	36.0	2.2	2.9
Construction Commuter Automobiles (tpy):	1.7	2.7	12.9	0.1	6.4
Total Construction-Related Activities (tpy):	13.1	41.5	48.9	2.3	9.3
Brevard County 1995 Total (tpy, for comparison)	24,983	26,122	13,4743	27,524	35,090

CO = carbon monoxide
lbs = pounds
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
tpy = tons per year
VOC = volatile organic compound

Dust from construction activities should have minimal impacts on local communities either on or off site, based on the assumption that the dust from construction would be periodic and disperse relatively quickly. Exposure to nuisance dust above permissible exposure limits (established occupational health and safety standards) would be possible but unlikely (based on historical and expected construction activities). If exceedance of exposure limit is established, health and safety procedures would need to be implemented by the construction contractor(s) to minimize emission or exposure to dust (e.g., respirator protection, limit access to working zones) and to maintain compliance with OSHA requirements. Environmental regulations may require use of wetting agents applied to road surfaces to minimize total suspended particles.

Brevard County currently meets the FAAQS and NAAQS for ozone, SO_2, NO_x, CO, and PM_{10}. Because the area is in attainment for these pollutants, the FDEP has not been required to establish specific emission reduction measures. Construction emissions of criteria pollutants would not be sufficient to jeopardize the attainment status for these pollutants. Baseline emissions in Brevard County are below the levels that would cause nonattainment, and the peak-year construction emissions are only a small fraction of the baseline.

The U.S. EPA is currently drafting a revised NAAQS, which would include a lower standard for ozone, and a standard for particles less than 2.5 microns in diameter ($PM_{2.5}$). Based on the new NAAQS, the attainment status of Brevard County may change, particularly for ozone. Given this situation, emissions of ozone precursors (VOC and NO_x) should be minimized to prevent impacts relative to standards and regulatory thresholds that could apply in the future.

Although no impacts have been identified, emissions could be reduced by implementing standard procedures, such as vigorous water application during ground-disturbing activities, which would be utilized to mitigate fugitive dust emissions by at least 50 percent (U.S. Environmental Protection Agency, 1985). Decreasing the time period during which newly graded sites are exposed to the elements, coupled with the use of windbreaks, could further minimize airborne dust concentrations. Efficient scheduling of equipment use, implementation of a phased construction schedule to reduce the number of units operating simultaneously, and performance of regular vehicle engine maintenance could mitigate combustive emission impacts. Implementation of these measures could reduce combustive emission and air quality effects from construction activities associated with the Proposed Action by 10 to 25 percent. Emissions of VOC from architectural coatings could be mitigated by selecting coatings with low VOC content.

<u>Operations</u>

Pre- and Post-Launch Processing. Pre- and post-launch processing would result in minor amounts of air emissions from the following activities:

- Vehicle preparation, and assembly
- Vehicle fueling
- Mobile sources such as support equipment, commercial transport vehicles (including trucks and aircraft), and personal vehicles
- Point sources such as heating/power plants, generators, incinerators and storage tanks.

Emissions from pre- and post-launch processing include criteria pollutants and toxic or irritant pollutants (including HAPs). Emissions of criteria pollutants could cause or contribute to the nonattainment of NAAQS or FAAQS for the region. Emissions of pollutants can also cause localized health effects.

Vehicle Preparation and Assembly. The manufacturing of Concept A vehicle components occurs off site, and emissions have not been included in the scope of this EIS. The components arrive complete, requiring only final on-site safety and quality checks prior to assembly.

Some chemical use occurs in the vehicle preparation and assembly stages, as described in Section 4.6, Hazardous Materials and Hazardous Waste Management. Some of the materials used would evaporate, resulting in air emissions. Examples of these air emissions sources include: solvents from adhesives and coatings, methylene chloride from paint remover, and isopropanol for surface cleaning. Spray painting could cause a small amount of particulate emissions from airborne paint particles; however, these emissions are expected to be minimal.

In addition to chemical usage, some air emissions could be generated from mechanical processing. For example, grinding and sanding operations could release particulate emissions. However, there would be no large-scale operations that would generate air emissions, and therefore emissions from mechanical processing are expected to be minimal.

Permitting for specific pieces of preparation and assembly equipment must be addressed under the Florida permitting requirements (FAC 62-210 through 213). Each piece of equipment must comply with the emission, opacity, odor, and toxics limits in these regulations.

Cape Canaveral AS has submitted a Title V Operating Permit application, which is under review by the FDEP. If the EELV program proceeds prior to the completion of FDEP review of the application, new stationary sources associated with the program would require permitting under the existing construction and operating permit program. Cape Canaveral AS could then change the Title V Operating Permit application to accurately reflect any new equipment. If the EELV program is implemented after completion of the FDEP review, new stationary source equipment would either be addressed or documented as minimal under the operating permit program. To address the changes, an amendment to the Operating Permit would be required. If the changes are minimal, they could be implemented without a permit revision.

The contractor has committed to implementing the EELV program without the use of any Class I ODSs. The use of Class II ODSs (for refrigeration, etc.) would be minimized or eliminated.

Emissions of VOC from chemical use could be reduced by limiting the overall chemical usage in preparation at Cape Canaveral AS. Chemical substitution could minimize the usage of HAPs; emissions of VOC and particulates from post-launch refurbishment could be mitigated by designing the SLC to minimize refurbishment. Emissions of VOCs from architectural coatings could be mitigated by selecting coatings with low VOC content.

Vehicle Fueling. Fueling of hydrogen for the CUS would involve some venting of hydrogen during bulk fuel transfer, fuel system checkout, and post-launch fuel system purging. Vented hydrogen would be controlled using a flare, which uses propane as auxiliary fuel. Emissions of combustion products from the hydrogen control flares were estimated using EPA AP-42 standard factors for external combustion. Emission rates would be very small (significantly less than 1 ton/year of all pollutants).

EPA AP-42 emission factors have been used to estimate emissions from RP-1 storage and fueling for the common booster(s). Estimates have been made for working emissions, caused by filling and emptying the storage tanks (including line purges), and breathing emissions, caused by daily warming and cooling of the tanks in the sunlight. Because RP-1 is not a very volatile fuel, emissions from RP-1 storage tanks are small (about 50 pounds per year). Currently, it is not anticipated that vapor control would be necessary for RP-1 storage and transfer equipment at Cape Canaveral AS. The final determination for control requirements would depend on the results of the Florida permitting process.

Emissions from hydrazine and N_2O_4 loading would be controlled by a combination of sealed transfer systems, wet scrubbing, and oxidation. The loading of MMH used in the SUS would be controlled using the existing fuel vapor incineration system (FVIS), which uses propane and excess air to oxidize the MMH into CO_2, nitrogen gas, and water. The FVIS is currently being used for the Titan IVB program to control emissions of A-50. The loading of N_2O_4 used in the SUS would be controlled using the existing oxidizer vapor scrubber system (OVSS), which uses a 25-percent sodium hydroxide solution as the scrubbing medium in a 4-tower, 1,500-gallon scrubber system. The sodium hydroxide solution converts N_2O_4 into aqueous sodium nitrate and aqueous sodium nitrite.

Hydrazine emissions are listed as HAP emissions. Emission rates of N_2O_4 are minimal compared to other sources of nitrogen oxides (much less than 1 ton per year).

After vehicle launch, the SLC must be cleaned and repaired. Surfaces are cleaned using an abrasive blaster, applying ablative coatings, and touching up or repainting painted surfaces. Particulate emissions from sandblasting have been estimated based on estimated abrasive use and a particulate emission factor. VOC emissions from coatings were obtained from the chemical usage described in Section 4.6, Hazardous Materials and Hazardous Waste Management, and an estimated evaporation rate.

Emissions could be reduced by using sealed transfer systems, wet scrubbing, and oxidation when loading hydrazine and N_2O_4. The final determination for control devices would depend on the results of the Florida permitting process.

Mobile Sources. Mobile sources of emissions for the baseline include vehicle deliveries, vehicle assembly and on-site transport, and personal automobile use and miscellaneous supply traffic.

Vehicle Deliveries. Concept A vehicle components would be delivered by truck and airplane. Truck emissions have been calculated using pounds of emissions per vehicle mile traveled. Emission factors were taken from the MOBILE 5a and PART5 computer models; emissions from required escort cars for oversized loads were calculated similarly.

Because the ROI for Cape Canaveral AS includes all of Brevard County, transportation emissions have been calculated for all Brevard County vehicular traffic that would be directly related to the EELV program.

Deliveries made by truck were assumed to involve round-trip traffic to and from the northern county line (50 percent) or the southern county line (50 percent). Travel along Interstate 95 was assumed.

It was assumed that aircraft deliveries would be made using a C-17 aircraft. Emissions from the C-17 aircraft were calculated using C-17A aircraft emission factors associated with landing and take-off. These factors are from Pratt & Whitney calculations and Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources, "Modifications to Guidance Document, Chapter 5: Emissions from Aircraft" (U.S. Environmental Protection Agency, 1991). Aircraft would be used to transport boosters and CUSs. It was assumed that one aircraft would be used for each component delivered.

Vehicle Assembly and On-Site Transport. Assembly of the vehicle components and on-site transport of the vehicle involves emissions from mobile sources, several of which are standard vehicles (trucks, forklifts). Emissions from these sources were estimated using VMT and the emission factors available in the MOBILE 5a and PART5 computer models. Other mobile sources (cranes, specialized transport vehicles) are not standard and have no associated standard emission factors. Emissions from these vehicles have been calculated using hours of operation, rated capacity (in horsepower), and the stationary source AP-42 emission factors for the appropriate engine types. Pollutant activities from these sources are relatively minor, and general estimates were used where specific data were not available.

Personal Automobile Use and Miscellaneous Supply Traffic. Emissions from automobile use and supply traffic were calculated based on both on-site and off-site emissions. The method of calculation is based on VMT and the emission factors available in MOBILE5a and PART5 computer models, discussed in detail in Section 3.10.2. A surge in automobile traffic prior to launch has been accounted for in the calculations.

Emissions from mobile sources could be mitigated by minimizing trip occurrences and trip lengths, and by improving emissions controls on mobile sources. Potential operational mitigation measures would focus on land use or transportation planning and management measures to reduce motor vehicle pollution. Types of potential mitigation measures would include: (1) use of centralized parking areas and shuttle systems to reduce personal vehicle use on station; (2) promotion of carpools and vanpools by providing a rider matching service, preferential parking, and financial incentives; (3) improvements such as bicycle lanes, storage facilities, and showers to increase the use of bicycling as a mode of transportation; and (4) on-station location of facilities that would reduce the need for off-station travel (e.g., childcare facilities, cafeterias, postal machines, automated tellers). These measures would reduce VMT, vehicle trips, and peak-hour travel, and therefore reduce both regional and localized vehicle-related emissions of criteria pollutants.

Point Sources. Point sources would include combustion sources, such as boilers and internal combustion engines. There would be no new fuel-fired boilers or heaters for this concept; some existing equipment would be used. However, some propane combustion would be required for operation of the hydrogen control flare and the FVIS. Emissions from other point sources such as spray booths and solvent cleaning equipment have been included in the total emission calculations for vehicle preparation and assembly. Permitting for specific pieces of preparation and assembly equipment must be addressed under the Florida permitting requirements (FAC 62-210 through 213). Stationary sources must be addressed under the Title V program to determine whether a Title V permit modification would be required.

Emissions from boilers and other external combustion sources were estimated based on the program's estimated utility requirements. Propane usage is provided in therms per day, and EPA AP-42 emission factors were used to calculate emission estimates from combustion of propane.

Emissions from internal combustion sources have been estimated based on the use of three emergency generators (two 1,000 kW and one 350 kW) operating an assumed 52 hours/year (one weekly one-hour test); and three small engines (welders, compressors) of 50-brake horsepower each, operating an assumed 500 hours/year. EPA AP-42 emission factors have been used to calculate emissions estimates from combustion of these sources.

The duration and magnitude of emissions associated with vehicle preparation and assembly are such that any increase in localized air pollutant concentrations would be relatively small and short-lived. Local effects would be consistent with the effects from similar light industrial activities. Exposure to pollutant levels in the ambient air above permissible exposure limits would be possible but unlikely (based on similar historical and expected operational activities). Any health risks would more likely be associated with improper ventilation of pollutants. Health risks to on-site personnel could be minimized by providing proper ventilation of pollutants and compliance with OSHA requirements.

Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program. These impacts are addressed under Regional Air Quality Impacts, and are summarized in Table 4.10-5.

Launch Activities

Launch Emissions. The rapid combustion of fuel during vehicle launch produces emissions. The release of unburned fuel and the generation of NO_x from the heat generated by launch also produce emissions. In addition, the baking and scouring effect of the launch exhaust on the launch pad may produce a small amount of particulates and combustion product emissions.

Concept A launch vehicles would use a booster that burns RP-1 and LO_2. The composition of the after-burning emissions is very similar to that of the Atlas IIA core booster. Launches from Cape Canaveral AS are primarily GTO missions, and the flight trajectory typical of such a mission was used to estimate the amount of booster mass emitted into the lower atmosphere (0-3,000 feet). The launch vehicles would spend 29 seconds in the lower atmosphere for a GTO mission.

The chemicals of concern include the tropospheric criteria pollutants for which NAAQS apply (NO_x as NO_2, and CO) and tropospheric precursors to ozone (NO_x and reactive VOCs). Table 4.10-2 summarizes the total mass of the various chemicals of concern released into the lower atmosphere from vehicle exhaust and after-burning during a GTO mission.

Table 4.10-2. Summary of Flight Emissions Deposited in the Lower Atmosphere, Concept A[a] (in tons)

Launch Vehicle	Particulate	NO_x	CO	VOC
MLV-A	0.0	0.74	0.0	0.0
MLV-D	0.0	0.74	0.0	0.0
HLV-L	0.0	2.23	0.0	0.0
HLV-G	0.0	2.23	0.0	0.0

Note: (a) Assumes a geosynchronous transfer orbit mission.
CO = carbon monoxide
HLV = heavy lift variant
MLV = medium lift variant
NO_x = nitrogen oxides
VOC = volatile organic compound

Localized air quality impacts were assessed using the REEDM model. REEDM produces peak puff and 30-minute average concentration estimates. Many ambient air quality standards are expressed as 1-, 8-, and 24-hour averages, or an instantaneous ceiling. Launch emissions occur over periods of minutes, and the launch plume rapidly clears the pad. An 8-hour average concentration was developed, assuming air quality impacts during 30 minutes of the 8-hour period. A maximum 8-hour average was developed by dividing the 30-minute average by 16. REEDM can also predict a peak puff concentration estimate as the puff moves over the receptor site. Tables for peak hourly and daily CO and NO_x predictions were produced. Rather than producing tables of each toxic hydrazine compound, the concentrations were summed for all hydrazine compounds. Separate tables of NH_3 concentrations were compiled when relevant, and tables for peak puff HCl concentrations were also compiled.

In practice, the REEDM results are compared with Tier 1, Tier 2, and Tier 3 recommended exposure criteria prior to allowing a launch to proceed (see Section 3.7, Health and Safety).

The REEDM modeling exercises should be interpreted as screening tools; a systematic search for the worst-case meteorology beyond simple low wind speed conditions was not conducted. The worst-case modeling scenario depends on a number of factors including where the receptors of importance are located relative to the launch pad, the vertical profile of wind speed and direction, the atmospheric stability and the height of the mixed layer, and the stability/thickness of any capping inversion.

The predicted incremental concentrations for nominal (normal) launches for Concept A vehicles are presented in Table 4.10-3.

Table 4.10-3. Summary of REEDM-Predicted Ambient Air Concentration Increments During Nominal Launches, Concept A

CO	Peak 8-hour average concentration increment (ppm)	NAAQS/FAAQS 8-hour average (ppm)
MLV-D	0.0	9
MLV-A	0.0	9
HLV-L	0.0	9
HLV-G	0.0	9
NO_x	Maximum 1-hour average concentration increment (ppm)	OSHA PEL ceiling (ppm)
MLV-D	0.114	5
MLV-A	0.114	5
HLV-L	0.162	5
HLV-G	0.162	5

CO = carbon monoxide
FAAQS = Florida Ambient Air Quality Standards
HLV = heavy lift variant
MLV = medium lift variant
NAAQS = National Ambient Air Quality Standards
NO_x = nitrogen oxides
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Level
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

Table 4.10-3 indicates that since the launch would be a transient source, the 8-hour average CO concentration increment would only be a small fraction of the NAAQS and FAAQS.

The NAAQS for NO_x is an annual standard, and the annual average is not substantially perturbed by the transient releases from launches. For comparison purposes, the Permissible Exposure Level (PEL) is shown, although this limit is not directly applicable to the EELV program. The PEL is a worker exposure limit; EELV program activities are not required to comply with this limit. The PEL is from the federal OSHA standards codified under Title 29 CFR 1910, Subpart Z. For conservative purposes, it has been assumed that all NO in NO_x is converted to NO_2 rapidly. In the absence of an applicable regulatory standard, the results indicate that the predicted NO_x maximum 30-minute average ($NO + NO_2$) concentration increment would be a small fraction of the OSHA PEL.

Additional details and modeling results are presented in Appendix J. Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program.

Launch Failure Emissions. In addition to scheduled launches, on rare occasions, a launch could fail. Such a failure would result in deflagration, in which the fuel from all stages is explosively burned. Deflagrations result in a hot, buoyant ground cloud that is dispersed in the first 10,000 feet. Although the release of pollutants is an unscheduled event, it is important to consider the air quality impacts and any consequent risks that may arise. The air quality concentrations of criteria pollutants normally released during a successful launch might be larger for an aborted launch. An even more important concern is that there may be significant concentrations of toxic compounds that are normally released at much higher flight elevations, or that are released only because of uncontrolled combustion processes. The toxic compounds in the ground cloud can drift downwind and pose some degree of threat to at-risk animal and plant populations.

Emissions from launch failures have been estimated using the Aerospace fireball deflagration model (Brady et al., 1997) (Table 4.10-4). This model estimates the fate of the propellants and oxidants that are on board the vehicle. For the model runs, it was assumed that deflagration would occur on the launch pad. The possible fates of the propellants and oxidants are (1) combustion reaction with other propellants producing chemicals of concern and other reaction products; (2) thermal decomposition due to the high temperatures in the fireball; and (3) secondary non-combustion conversion to a chemical of concern or some other reaction product. The fractional masses of each propellant and oxidant for each fate were estimated utilizing the fireball model and then input into the REEDM model. The total emissions resulting from the deflagration fireball were estimated from the fate mass fractions and the total load of propellants and oxidants on the vehicle.

Table 4.10-4. Summary of REEDM-Predicted Ambient Air Concentration Increments During Aborted Launches, Concept A

CO	Peak 8-hour average concentration increment (ppm)	NAAQS/FAAQS 8-hour average (ppm)
MLV-D	0.225	9
MLV-A	0.130	9
HLV-L	0.413	9
HLV-G	0.244	9
NO_x	Maximum 1-hour average concentration increment (ppm)	OSHA PEL ceiling (ppm)
MLV-D	0.227	5
MLV-A	NA	5
HLV-L	0.139	5
HLV-G	NA	5
NH_3	Maximum 30-minute average concentration increment (ppm)	OSHA PEL 8-hour average (ppm)
MLV-D	NA	50
MLV-A	0.004	50
HLV-L	NA	50
HLV-G	0.003	50
Hydrazine Compounds	Maximum 30-minute average concentration increment (ppm)	OSHA PEL 8-hour average (ppm)
MLV-D	0.025	1
MLV-A	0.0	1
HLV-L	0.015	1
HLV-G	0.0	1

CO = carbon monoxide
FAAQS = Florida Ambient Air Quality Standards
HLV = heavy lift variant
MLV = medium lift variant
NAAQS = National Ambient Air Quality Standards
NH_3 = ammonia
NO_x = nitrogen oxides
NA = not applicable
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Level
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

Concept A chemical of concern emissions from deflagration for each vehicle are summarized in Appendix J.

NH_3 was predicted by REEDM for the MLV-A and HLV-G abort scenarios. In the absence of an applicable regulatory standard, the OSHA PEL is shown for comparison, although it does not directly apply. The incremental concentrations are typical of rural ambient concentrations and would not pose any short-term health hazards.

For MLV-A and HLV-G vehicles, REEDM did not predict NO or NO_2 incremental concentrations during an abort. In the absence of an applicable regulatory standard, the results indicate that the predicted NO_x concentration increment would be a small fraction of the OSHA PEL.
Hydrazine compound concentrations have been estimated by REEDM for aborts of each launch vehicle. In the absence of an applicable regulatory standard, the OSHA PEL is shown for comparison. The maximum concentrations of hydrazine compounds are actually predicted for the smaller launch vehicle, possibly due to increased buoyancy making the final centerline height larger and the ground level concentrations smaller.

Regional Air Quality Impacts

Regional air quality impacts are best summarized by totaling the emissions in the ROI associated with the program. Criteria pollutants are of concern for long-term impacts over the entire air quality region (Brevard County).

Annual emission rates depend on the proposed launch schedule (see Table 2.1-3). The emission summary for selected years from 2001 to 2020 is presented in Appendix J. The year of peak emissions into the lower atmosphere at Cape Canaveral AS is 2015 (Table 4.10-5).

Table 4.10-5. Emission Comparison, Concept A - Cape Canaveral AS[(a)]

	Emissions (in tons)[(b)]				
	VOC	NO_x	CO	SO_2	PM_{10}
Launches	0.0	18.5	0.0	0.0	0.0
Preparation, Assembly, and Fueling	18.0	0.0	0.0	0.0	7.6
Mobile Sources	5.1	15.0	38.9	0.6	43.0
Point Sources	0.3	4.6	0.9	0.2	0.3
Total	23.4	38.0	39.8	0.8	50.9
Brevard County 1995 Total (for comparison)	24,983	26,122	13,4743	27,524	35,090

Notes: (a)Includes emissions into the lower atmosphere (<3,000 feet) only.
(b)Emissions are based on launch rates shown in Table 2.1-3 for the peak emissions year at Cape Canaveral AS (2015)

AS = Air Station
CO = carbon monoxide
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

Peak-year operation emissions of criteria pollutants would not jeopardize the attainment status for these pollutants, assuming that the attainment status criteria are the same in 2015 and everything else remains equal in Brevard County. Current baseline emissions in Brevard County are below the levels that would cause nonattainment, and the peak-year operation emissions would be only a small fraction of the county baseline. In addition, based on current emissions estimates, Concept A would result in a reduction of emissions from the baseline for all criteria pollutants.

4.10.1.1.2 Concept A - Vandenberg AFB. Localized air quality impacts can be addressed for Vandenberg AFB in a manner similar to that used for Cape Canaveral AS using methods described in Appendix J. Because of the attainment status and regulatory framework at Vandenberg AFB, regional air quality impacts must be assessed using additional thresholds and criteria, as described below.

Vandenberg AFB is situated in an area designated by the EPA as being in nonattainment of the ozone standard. The EELV program at this location would need to comply with air conformity requirements as defined in 40 CFR, 51 Subpart W, Section 176(c) of the CAA. The conformity rule defines the applicability criteria, including several source exemptions and de minimis emission thresholds, which determine if a federal action in a nonattainment area must conform or is exempt from conforming with the applicable SIP. If the total of indirect and direct emissions of a criteria pollutant in nonattainment exceeds the defined de minimis thresholds, a formal Air Conformity Determination is required. Requirements of an Air Conformity Determination include a public participation process and the demonstration of conformity with the SIP. General conformity prohibits the federal government from engaging in an activity that does not conform to the applicable SIP. Completion of an air conformity applicability analysis or an Air Conformity Determination does not exempt the federal action from any other requirements of the applicable SIP, the NEPA, or the CAA. Appendix K presents the required air conformity applicability analysis for the EELV program at Vandenberg AFB.

Changes associated with the EELV program would need to be documented in the ENVVEST reporting for Vandenberg AFB. Specifically, emissions from any stationary sources associated with EELV activities would need to be reported as part of the emissions from a source group. If emissions from any source group exceed applicable Title V permitting minimums, implementation of the ENVVEST program can be affected.

Under the current Rule 1301 source groups, the EELV stationary sources would likely fall under either the designation “Range Group” or “Commercial Space.” Actual emissions from each source group for 1994 are summarized in the table “Summary of Actual Emissions by SIC Major Group Code,” prepared by U.S. Air Force on April 24, 1997, and included in Appendix J. Based on this summary, NO_x emissions from the “Range Group” source group were 20.3 tons for 1994, compared to a Rule 1301 threshold of 25 tons. Emissions of NO_x from this group can therefore increase by 4.7 tons before the ENVVEST program is affected. The NO_x emissions from the “Commercial Space” source group were 0.3 ton for 1994; emissions from this group can therefore increase by 24.7 tons before the ENVVEST program is affected.

The Concept A contractor plans to use existing boilers and heaters (NO_x sources) for this program. The existing boilers and heaters will be used for the EELV program instead of their current uses. The total estimated emissions of NO_x from these point sources is 4.5 tons per year, as shown in Table 4.10-10. These emissions will replace the baseline emissions (emissions associated with the current Atlas, Delta, and Titan programs). The total estimated baseline emissions of NO_x from point sources is 8.1 tons, as shown in Table 3.10-9. Therefore, implementing the Concept A EELV program is expected to decrease NO_x emissions by 3.6 tons per year. Because total emissions are expected to decrease, the EELV activities are not likely to negatively impact implementation of the ENVVEST program.

Facility Construction

Facility construction for Concept A operations at Vandenberg AFB would involve major renovation and selective new construction at SLC-3W. Major modifications would involve disturbing approximately 33 acres within the fence line at SLC-3W. Stripping, excavating, site clearing, backfilling, and compaction are expected to take place on about 16 acres per year. Ultimately, a total of 78,226 square feet has been assumed to require repaving. A combined total of 195,565 square feet of buildings and other structures would be constructed or renovated. Most of the construction would involve modifications to existing structures within the SLC-3W fenceline.

All emissions of pollutants were developed using an approach identical to that described for Cape Canaveral AS in Section 4.10.1.1.1, and in Appendix J. Climatological parameters used in the calculation reflect wind speed and rainfall days appropriate to the Los Angeles, California, area (Table 4.10-6).

Table 4.10-6. Construction-Related Emissions - Concept A, Vandenberg AFB Average Annual Emissions Over Construction Period

Equipment	VOC	NO_x	CO	SO_2	PM_{10}
Grading Equipment (lbs/day):	4.0	25.4	5.5	1.7	4.5
Asphalt Paving (lbs/day):	0.2	0.0	0.0	0.0	0.0
Stationary Equipment (lbs/day):	15.8	12.9	2.8	0.9	0.8
Mobile Equipment (lbs/day):	15.0	151.1	150.3	7.0	11.3
Architectural Coatings (lbs/day):	25.0	0.0	0.0	0.0	0.0
Total Emissions (lbs/day):	60.0	189.4	158.6	9.6	16.5
Total Emissions (tpy):	6.9	21.8	18.2	1.1	1.9
Construction Commuter Automobiles (tpy)	1.7	1.7	19.6	0.1	8.0
Total Construction-Related Activities (tpy)	8.6	23.5	37.8	1.2	9.9
Santa Barbara County 1995 Total (tpy, for comparison)	44,664	13,994	102,509	1,290	29,374

CO = carbon monoxide
lbs = pounds
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
tpy = tons per year
VOC = volatile organic compound

In addition to emissions that are directly construction-related, there would be emissions associated with commuter traffic (see Appendix J).

Local concentrations of criteria pollutants would increase during the construction phase as described in Section 4.10.1.1.1. Dust from construction activities should have minimal impacts on local communities on- and off-site. Impacts would be similar to those discussed for Cape Canaveral AS in Section 4.10.1.1.1.

The expected emissions of ozone precursors (VOC and NO_x) and PM_{10} from construction are small compared with the county baseline. However, since the SCCAB is in non-attainment for ozone and PM_{10} for state standards, these emissions would still be mitigated to the extent feasible.

Construction emissions of SO_2, NO_x, and CO would not jeopardize the attainment status for these pollutants. Baseline emissions in the SCCAB are below levels that would cause nonattainment, and the peak-year construction emissions are only a small fraction of the county baseline.

According to SBCAPCD Rule 202, permits are not required for engines used in construction activities. However, if the combined emissions from all construction equipment used to construct a stationary source that requires a permit have the potential to exceed 25 tons per year of SO_2, NO_x, PM_{10}, or VOC, emissions offsets must be obtained and the owner must demonstrate that no ambient air quality standard would be violated.

Measures to reduce emissions during the construction phase would be similar to those discussed for Cape Canaveral AS.

Operations

Pre- and Post-launch Processing. Pre- and post-launch processing for Concept A operations at Vandenberg AFB would result in minor amounts of air emissions from activities similar to those described in Section 4.10.1.1.1. Emissions of criteria pollutants could cause or contribute to the nonattainment of NAAQS or CAAQS for the region. Emissions of pollutants can also cause localized health effects.

Vehicle Preparation and Assembly. Procedures for vehicle preparation and assembly would be similar to those described in Section 4.10.1.1.1. Permitting for specific pieces of preparation and assembly equipment must be addressed under the California regional permitting requirements (SBCAPCD Regulation II). The use of toxic chemicals must be addressed under CCR 17-93000 et seq. (Toxic Air Contaminants); an Air Toxics “Hot Spots” questionnaire may need to be submitted. Changes would need to be documented in the ENVVEST reporting and could affect the status of Vandenberg AFB with regard to operating permit requirements.
Measures to reduce emissions would be taken during vehicle preparation and assembly similar to those discussed for Cape Canaveral AS.

Vehicle Fueling. Fueling of hydrogen for the CUS involves some venting of hydrogen during bulk fuel transfer, fuel system checkout, and post-launch fuel system purging. Emissions of combustion products from the hydrogen control flares have been estimated as described in Section 4.10.1.1.1.

Emission from RP-1 storage and fueling were estimated as described for Cape Canaveral AS in Section 4.10.1.1.1, and emissions would be minimal (less than 50 pounds per year). Existing RP-1 storage and handling equipment at SLC-3W has been permitted under Operating Permit 7397-02. This permit may need to be modified to allow for the changes in equipment and increased throughput (over the current 78,000 gallon-per-year limit). There are no vapor control requirements for the existing RP-1 equipment. The final determination for control requirements for the new equipment would depend on the results of the SBCAPCD permitting process.

A combination of sealed transfer systems and portable scrubbers would be used to control emissions from hydrazine and N_2O_4 loading. The loading of MMH used in the SUS would be controlled using an existing portable bubble-cap scrubber, which uses water to trap hydrazine fuels. An existing portable scrubber similar to the oxidizer vapor scrubber system used for Titan IV operations would be used to control the loading of N_2O_4 used in the SUS.

Emissions of hydrazine are listed as HAP emissions. Emissions of N_2O_4 are minimal compared to other sources of nitrogen oxides (much less than 1 ton per year). The wet scrubbing systems have been permitted by SBCAPCD; these permits may need to be modified to reflect the change in operations.

After vehicle launch, the SLC must be cleaned and repaired. Surfaces are cleaned using a wire brush system, ablative coatings are applied, and painted surfaces are touched up or repainted. Particulate emissions from sandblasting were estimated based on typical abrasive use and a particulate emission factor, with an estimated 90-percent emissions reduction due to use of wire brushes instead of an abrasive blast system. VOC emissions from coatings were obtained from the chemical usage described in Section 4.6, Hazardous Materials and Hazardous Waste Management, and an estimated evaporation rate.

Emissions from the vehicle fueling operations could be reduced through the same measures described for Cape Canaveral AS. The final determination for control devices would depend on the results of the SBCAPCD permitting process.

Mobile Sources. Mobile sources of emissions would be the same as described in Section 4.10.1.1.1.

Vehicle Deliveries

Concept A vehicle components would be delivered by truck and aircraft. Emissions have been calculated as described in Section 4.10.1.1.1. Emission factors were taken from the EMFAC 7f and PART5 computer models; emissions from required escort cars for oversized loads were calculated similarly.

Because the ROI for Vandenberg AFB includes all of the SCCAB, transportation emissions have been calculated for all vehicular traffic in Santa Barbara, San Luis Obispo, and Ventura counties directly related to the EELV program.

Deliveries made by truck were assumed to involve round-trip traffic to and from the northern San Luis Obispo County line (50 percent) or the eastern Ventura County line (50 percent).

Aircraft emissions were estimated using the procedures described for Cape Canaveral AS in Section 4.10.1.1.1.

Vehicle Assembly and On-Site Transport. Assembly of the vehicle components and on-site transport of the vehicle would involve emissions from mobile sources (see Section 4.10.1.1.1). Emissions from these sources were estimated using VMT and the emission factors available in the EMFAC 7f and PART5 computer models. Other mobile sources emissions were calculated as described in Section 4.10.1.1.1.

Personal Automobile Use and Miscellaneous Supply Traffic. Emissions from automobile use and supply traffic were calculated based on both on- and off-site emissions. Emissions were calculated using VMT and the emission factors available in the EMFAC 7f and PART5 computer models. A surge in automobile traffic prior to launch has been accounted for in the calculations.

Emissions from mobile sources could be reduced by minimizing trip occurrences and trip lengths, and by improving emissions controls on mobile sources, as described in Section 4.10.1.1.1.

Point Sources. Point sources would include combustion sources, such as boilers and internal combustion engines (see Section 4.10.1.1.1). Also, some equipment currently at Vandenberg AFB would be used for the EELV program. Emissions from other point sources such as spray booths and solvent cleaning equipment have been included in the total emission calculations for vehicle preparation and assembly. Permitting for specific pieces of preparation and assembly equipment must be addressed under the SBCAPCD permitting requirements (Regulation II), and changes must be reflected in the ENVVEST reporting.

Emissions from boilers and other external combustion sources were estimated based on the estimated utility requirements for the program. Natural gas usage is provided in therms per day, and general EPA AP-42 emission factors were used to estimate emissions from combustion of natural gas.

Emissions from internal combustion sources were estimated based on the use of three emergency generators (two 1,000 kW and one 350 kW) operating an assumed 52 hours/year (one weekly one-hour test); and three small engines (welders, compressors, etc.) of 50 brake horsepower each, operating an assumed 500 hours/year. EPA AP-42 emission factors were used to calculate emissions estimates from combustion of these sources.

Emissions from point sources could be reduced through the use of propane instead of residual oil or solid fuel.

Impacts would be similar to those discussed in Section 4.10.1.1.1.

Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program. These impacts are addressed under Regional Air Quality Impacts and are summarized in Table 4.10-10.

Launch Activities

Launch Emissions. Vehicle launch emissions would occur as described in Section 4.10.1.1.1.

Concept A launch vehicles would use a booster that burns RP-1 and LO_2. The composition of the after-burning emissions is very similar to that of the Atlas IIA core booster. Launches from Vandenberg AFB are primarily LEO missions, and the flight trajectory for such a mission was used to estimate the amount of booster mass emitted into the lower atmosphere (0-3,000 feet) ROI. The launch vehicles would spend only 19 seconds in the lower atmosphere for an LEO mission.

The chemicals of concern include the tropospheric criteria pollutants for which NAAQS apply (NO_x, NO_2, and CO) and tropospheric precursors to ozone (NO_x and reactive VOCs). Table 4.10-7 summarizes the total mass of the various chemicals of concern released into the lower atmosphere from vehicle exhaust and after-burning during a LEO mission.

Localized air quality impacts have been assessed using the REEDM model (Table 4.10-8). The REEDM modeling for Vandenberg AFB should be interpreted as a screening tool; a systematic search for the worst-case meteorology was not conducted. In some, but not all cases, both a Vandenberg AFB and Cape Canaveral AS simulation were run for each launch vehicle. The differences in the predictions are minor owing to similar

Table 4.10-7. Summary of Flight Emissions Deposited in the Lower Atmosphere, Concept A[a] (in tons)

Launch Vehicle	Particulate	NO_x	CO	VOC
MLV-A	0.0	0.48	0.0	0.0
MLV-D	0.0	0.48	0.0	0.0
HLV-L	0.0	1.44	0.0	0.0
HLV-G	0.0	1.44	0.0	0.0

Note: (a) Assumes a low-Earth orbit mission.
CO = carbon monoxide
HLV = heavy lift variant
MLV = medium lift variant
NO_x = nitrogen oxides
VOC = volatile organic compound

Table 4.10-8. Summary of REEDM-Predicted Ambient Air Concentration Increments for NO_x During Nominal Launches, Concept A

	Maximum 1-hour average concentration increment (ppm)	CAAQS 1-hour average NO_2 standard (ppm)
MLV-D	0.114	0.25
MLV-A	0.114	0.25
HLV-L	0.162	0.25
HLV-G	0.162	0.25

CAAQS = California Ambient Air Quality Standards
HLV = heavy lift variant
MLV = medium lift variant
NO_2 = nitrogen dioxide
NO_x = nitrogen oxides
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

meteorological inputs. Therefore, the modeling results presented in Section 4.10.1.1.1 also apply to Vandenberg AFB.

Additional details and modeling results are presented in Appendix J. Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program.

Launch Failure Emissions. Emissions from launch failures at Vandenberg AFB have been estimated using the Aerospace fireball deflagration model (Brady et al., 1997) (Table 4.10-9). The mass emission rates calculated from Concept A launch failures are the same at Vandenberg AFB as those shown for Cape Canaveral AS in Section 4.10.1.1.1.

The CAAQS has an hourly NO_2 standard of 0.25 ppm. For conservative purposes, all NO in NO_x is assumed to convert to NO_2 rapidly. The REEDM-predicted NO_x (NO + NO_2) incremental concentrations resulting from the aborts of Concept A vehicles have been summarized in Table 4.10-9.

For the MLV-A and HVL-G vehicles, REEDM did not predict NO or NO_2 incremental concentrations during an abort. The results indicate that in the

Table 4.10-9. Summary of REEDM-Predicted Ambient Air Concentration Increments for NO_x During Aborted Launches, Concept A

	Peak 1-hour average concentration increment (ppm)	CAAQS 1-hour average NO_2 standard (ppm)
MLV-D	0.114	0.25
MLV-A	NA	0.25
HLV-L	0.057	0.25
HLV-G	NA	0.25

CAAQS = California Ambient Air Quality Standards
HLV = heavy lift variant
MLV = medium lift variant
NA = not applicable
NO_2 = nitrogen dioxide
NO_x = nitrogen oxides
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

worst case, the predicted maximum hourly NO_x concentration increment is one-half of the hourly NO_2 standard.

Regional Air Quality Impacts

Regional impacts on the lower atmosphere are best summarized by totaling the emissions in the ROI associated with the program. Criteria pollutants are of concern for long-term impacts over the entire air quality region (SCCAB).

Annual emission rates depend on the proposed launch schedule (see Table 2.1-3). Many of the emission-generating activities occur once per vehicle launch. Launch emissions are summarized for the peak year (2007) in Table 4.10-10. A summary of launch emissions for other key years between 2001 and 2020 is presented in Appendix J.

The expected emissions of ozone precursors (VOC and NO_x) and PM_{10} from peak-year operation are minimal compared with the county baseline. However, since the SCCAB is in nonattainment for ozone and PM_{10} for state standards, these emissions would still be mitigated to the extent feasible.

Peak-year operation emissions of SO_2, NO_x, and CO would not jeopardize the attainment status for these pollutants, assuming that attainment status criteria are the same in the peak year, and everything else remains equal in Santa Barbara County. Baseline emissions in the SCCAB are below the levels that would cause nonattainment, and the peak-year construction emissions are only a small fraction of the county baseline.

Based on current emissions estimates, Concept A would result in a reduction of emissions from the baseline for all criteria pollutants. The final system design would need to be compared with the permitting and regulatory requirements listed in Section 3.10 to determine the required action.

Table 4.10-10. Emission Comparison, Concept A - Vandenberg AFB[a]

	Emissions (in tons)[b]				
	VOC	NO_x	CO	SO_2	PM_{10}
Launches	0.0	4.8	0.0	0.0	0.0
Preparation, Assembly, and Fueling	7.5	0.0	0.0	0.0	0.3
Mobile Sources	2.2	4.4	27.5	0.2	34.5
Point Sources	0.3	4.5	0.9	0.2	0.3
Total	10.0	13.7	28.4	0.5	35.1
Santa Barbara County 1995 Total (for comparison)	44,664	13,994	102,509	1,290	29,374

Notes: (a) Includes emissions into the lower atmosphere (<3,000 feet) only.
(b) Emissions are based on launch rates shown in Table 2.1-3 for the peak emissions year at Vandenberg AFB (2007).

CO = carbon monoxide
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

Based upon current estimates of stationary source emissions and the emissions estimates from the ENVVEST source categories, it does not appear that installation of new stationary sources to support the EELV program would trigger new requirements under SBCAPCD Rule 1301. Vandenberg AFB would need to consider EELV operations when determining whether ENVVEST emission reduction goals are being met.

4.10.1.2 Concept B

4.10.1.2.1 Concept B - Cape Canaveral AS. Air quality impacts from Concept B operations would result from the general sources described in Section 4.10.1.1. Vehicle components would be delivered by truck, aircraft, rail, and barge; emissions from these vehicles were calculated and compared to existing mobile source emissions. Fuels used in the Concept B vehicles include cryogenic gases (LO_2 and LH_2), hydrazines (A-50 and N_2H_4), N_2O_4, and solid rocket propellant. Emissions from the handling and storage of these fuels were calculated and compared to existing emissions.

Facility Construction

Emissions generated by facility construction activities would be in the form of either gaseous or particulate pollutant emissions. Combustion product emissions would occur from construction equipment and worker vehicle travel to and from the site by construction workers, and particulate matter would occur from construction, as discussed for Concept A in Section 4.10.1.1. Facility construction for Concept B at Cape Canaveral AS would involve renovation and new construction at SLC-37 (Pads 37A and 37B) and at other locations on Cape Canaveral AS. A total of approximately 70 acres (net of buildings) would be disturbed as part of site clearing, stripping, excavating, backfilling, and compaction operations. Building renovations and new construction would involve approximately 823,600 square feet, with over 85 percent within the launch facilities area and the remainder remote from the launch site. Square footage for all individual structures was estimated from scale site plan drawings considering facilities with similar purposes at other military properties. All calculations were made on the basis of average annual emissions over the construction period.

Construction emissions have been calculated using the methods described for Concept A in Section 4.10.1.1. Table 4.10-11 provides a summary of construction-related emissions.

Table 4.10-11. Construction-Related Emissions - Concept B, Cape Canaveral AS Average Annual Emissions Over Construction Period

	VOC	NO_x	CO	SO_2	PM_{10}
Grading Equipment (lbs/day):	8.1	51.7	11.2	3.4	9.0
Asphalt Paving (lbs/day):	0.9	0.0	0.0	0.0	0.0
Stationary Equipment (lbs/day):	63.9	52.1	11.3	3.5	3.0
Mobile Equipment (lbs/day):	60.8	612.0	616.2	34.6	45.6
Architectural Coatings (lbs/day):	50.2	0.0	0.0	0.0	0.0
Total Emissions (lbs/day):	183.9	715.8	638.6	41.5	57.7
Total Emissions (tpy):	21.2	82.3	73.4	4.8	6.6
Construction Commuter Automobiles (tpy):	1.7	2.6	12.2	0.1	6.1
Total Construction-Related Activities (tpy):	22.9	84.9	85.6	4.7	12.7
Brevard County 1995 Total (tpy, for comparison)	24,983	26,122	13,4743	27,524	35,090

CO = carbon monoxide
lbs = pounds
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
tpy = tons per year
VOC = volatile organic compound

In addition to emissions that are directly construction-related, there would be emissions associated with commuter traffic. VMT for employees, including commuting distances and non-work trips, were calculated (see Appendix J).

Measures could be taken to reduce fugitive dust emissions from ground-disturbing activities and combustive emissions from construction equipment; these measures would be similar to those described for Concept A in Section 4.10.1.1.1.

Local concentrations of criteria pollutants would increase during the construction phase, as described in Section 4.10.1.1.1. Impacts would be temporary, local, and minor.

Dust from construction activities should have minimal impacts on local communities, either on or off site.

Brevard County currently meets the FAAQS and NAAQS for ozone, SO_2, NO_x, CO, and PM_{10}. Because the area is in attainment for these pollutants, the FDEP has not been required to establish specific emission reduction measures. As discussed in Section 4.10.1.1.1, the PSD process does not provide a mechanism for dealing with non-stationary sources such as motor vehicles and aircraft.

Construction emissions of criteria pollutants would not jeopardize the attainment status for these pollutants. Current Brevard County baseline emissions are below the levels that would cause nonattainment, and the peak-year construction emissions would be only a small fraction of the baseline.

Operations

Pre- and Post-Launch Processing. Pre- and post-launch processing for Concept B operations at Cape Canaveral AS would result in minor amounts of air emissions as described in Section 4.10.1.1.1.

Emissions from pre-launch and post-launch processing would include criteria pollutants and toxic or irritant pollutants (including HAPs). Emissions of criteria pollutants could cause or contribute to the nonattainment of NAAQS or FAAQS for the region. Emissions of pollutants can also cause localized health effects.

Vehicle Preparation and Assembly. Manufacturing of Concept B vehicle components would occur off site; emissions have not been included in the scope of this EIS. The components would arrive complete, requiring only final on-site safety and quality checks prior to assembly.

Some chemical use would occur in the vehicle preparation and assembly stages. Emissions from chemical use and permitting requirements would be similar to those described in Section 4.10.1.1.1. A discussion of the Title V Operating Permit Application and associated requirements is provided in Section 4.10.1.1.1.

The EELV contractor has committed to implementing the program without the use of any Class I ODSs. The use of Class II ODSs (for refrigeration, etc.) would be minimized or eliminated.

Emissions of VOCs could be reduced as described in Section 4.10.1.1.1.

Vehicle Fueling. Fueling of hydrogen would involve some venting of hydrogen during bulk fuel transfer, fuel system checkout, and post-launch fuel system purging. Vented hydrogen would be controlled using a flare, which uses propane as auxiliary fuel. Emissions of combustion products from the hydrogen control flares have been estimated using EPA AP-42 standard factors for external combustion. Emission rates would be very small (significantly less than 1 ton/year of all pollutants).

A combination of sealed transfer systems, wet scrubbing, and oxidation would be used to control emissions from hydrazine and N_2O_4 loading. The loading of hypergolic fuel used in the CUS would be controlled using packed-tower scrubber technology. Water is contacted with the exhaust gas in a counter-current-packed tower that allows for intimate air-water contact. The hydrazine fuel is absorbed by the water phase. The loading of N_2O_4 would be controlled using similar scrubber equipment. The system uses a caustic (sodium hydroxide) solution to convert N_2O_4 into aqueous nitrates and nitrites. An alternative to sodium hydroxide would be potassium hydroxide, which would have the benefit of creating a fertilizer product instead of a liquid hazardous waste.

Emissions of hydrazine are listed as HAPs. Emissions of N_2O_4 are minimal compared to other sources of nitrogen oxides (much less than 1 ton per year).

After vehicle launch, the SLC must be cleaned and repaired. Surfaces are cleaned using an abrasive blaster, ablative coatings are applied, and painted surfaces are touched up or repainted. Particulate emissions from sandblasting were estimated based on estimated abrasive use and a particulate emission factor. VOC emissions from coatings were obtained from coating use estimates.

Emissions from transfer of hydrazine and N_2O_4 could be reduced by using sealed transfer systems, wet scrubbing, and oxidation. Further mitigation could be achieved using expanded capture and control systems. The final determination for control devices would depend on the results of the Florida permitting process.

Mobile Sources. Mobile emission sources are described in Section 4.10.1.1.1.

Vehicle Deliveries. Concept B vehicle components would be delivered by truck, aircraft, rail, and barge. Truck emissions have been calculated using pounds of emissions per vehicle mile traveled. Emission factors were taken from the MOBILE 5a and PART5 computer models; emissions from required escort cars for oversized loads were calculated similarly.

Transportation emissions have been calculated as described in Section 4.10.1.1.1.

Concept B aircraft deliveries were assumed to be made using a C-5 Galaxy aircraft. Emissions from the C-5 aircraft associated with landing and take-off were calculated using the factors available in the Calculation Methods for Criteria Air Pollutant Emission Inventories (Jagielski and O'Brien, 1994).

It was assumed that Concept B barge deliveries would be made in an unpowered barge maneuvered by two tugboats of 900 horsepower each. A 1-hour-approach and a 2-hour return for the tugboats was assumed for emission estimates.

Vehicle Assembly and On-Site Transport. Assembly of the vehicle components and on-site transport of the vehicle would involve emissions from mobile sources. Emissions were calculated as described in Section 4.10.1.1.1.

Personal Automobile Use and Miscellaneous Supply Traffic. Emissions from automobile use and supply traffic were calculated as described in Section 4.10.1.1.1. Emissions from mobile sources could be reduced through implementation of measures described in Section 4.10.1.1.1.

Point Sources. Calculation of point source emissions would be the same as discussed in Section 4.10.1.1.1. Permitting for specific pieces of preparation and assembly equipment must be addressed under the Florida permitting requirements (FAC 62-210 through 213).

Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program. These impacts are addressed under Regional Air Quality Impacts and are summarized in Table 4.10-15.

Launch Activities

Launch Emissions. Vehicle launch emissions would occur as described in Section 4.10.1.1.1.

Concept B launch vehicles would use a booster that burns LH_2 and LO_2. The composition of the after-burning emissions would be very clean, essentially resulting in only water, unburned fuel, and oxy-hydrogen radicals. The primary flight trajectory of launches from Cape Canaveral AS is GTO. This trajectory was used to estimate the amount of booster mass emitted into the lower atmosphere (0-3,000 feet). The launch vehicles would spend only 29 seconds in the lower atmosphere for a GTO mission.

The chemicals of concern include the tropospheric criteria pollutants for which NAAQS apply (NO_x, CO) and tropospheric precursors to ozone (NO_x and reactive VOCs). Table 4.10-12 summarizes the total mass of the various chemicals of concern released into the lower atmosphere from vehicle exhaust and after-burning during a GTO mission.

Table 4.10-12. Summary of Flight Emissions Deposited in the Lower Atmosphere, Concept B[(a)] (in tons)

Launch Vehicle	Particulate	NO_x	CO	HCl	VOC
DIV-S	0.0	0.56	0.0	0.0	0.0
DIV-M	0.0	0.56	0.0	0.0	0.0
DIV-M+	4.19	0.74	0.0	2.16	0.0
DIV-H	0.0	1.69	0.0	0.0	0.0

Note: (a) Assumes a geosynchronous transfer orbit mission.
CO = carbon monoxide
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
HCl = hydrochloric acid
NO_x = nitrogen oxides
VOC = volatile organic compound

Emissions from launch operations (into the lower atmosphere) could be mitigated by the primary use of cryogenic fuels instead of solid rocket fuels, hydrazines, and/or N_2O_4.

Localized air quality impacts were assessed using the REEDM model, similar to the assessments made for Concept A in Section 4.10.1.1.1. The model results are presented in Table 4.10-13. Table 4.10-13 indicates that the 8-hour average concentration increment for CO would be only a very small fraction of the NAAQS and FAAQS.

The NAAQS for NO_x is an annual standard, and the annual average is not substantially perturbed by the transient releases from launches. For comparison purposes, the OSHA PEL is shown, although this limit is not directly applicable. For conservative purposes, it has been assumed that all NO in NO_x is converted to NO_2 rapidly.

The predicted ambient concentrations of NO or NO_2 for nominal launches actually show the effects of the increased buoyancy due to the extreme heat release of the three boosters. Due to increased plume rise, the

Table 4.10-13. Summary of REEDM-Predicted Ambient Air Concentration Increments During Nominal Launches, Concept B

CO	Maximum 8-hour average concentration increment (ppm)	NAAQS/FAAQS 8-hour average (ppm)
DIV-S	0.0	9
DIV-M	0.0	9
DIV-M+	0.0	9
DIV-H	0.0	9
NO_x	Maximum 30-minute average concentration increment (ppm)	OSHA PEL ceiling (ppm)
DIV-S	0.102	5
DIV-M	0.109	5
DIV-M+	0.119	5
DIV-H	0.020	5
HCl	Peak puff concentration increment (ppm)	OSHA PEL ceiling (ppm)
DIV-M+	0.293	5

CO = carbon monoxide
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
FAAQS = Florida Ambient Air Quality Standards
HCl = hydrochloric acid
NAAQS = National Ambient Air Quality Standards
NO_x = nitrogen oxides
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Level
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

concentrations at the ground decrease significantly. The results indicate that the highest predicted NO_x concentration increment would be a very small fraction of the OSHA PEL.

Launch Failure Emissions. As discussed in Section 4.10.1.1.1, a launch could fail on the pad. Emissions from launch failures have been estimated using the Aerospace fireball deflagration model (Brady et al., 1997) (Table 4.10-14). The Concept B emissions of chemicals of concern from deflagration for each vehicle are summarized in Appendix J.

NO or NO_2 incremental concentrations during an abort were predicted by REEDM for only the DIV-S vehicle configuration.

Ammonia was predicted by REEDM for all Concept B abort scenarios. The resulting maximum 30-minute average concentrations have been compared to the OSHA PEL, although they do not directly apply. Emissions would be a very small fraction of this PEL.

Table 4.10-14. Summary of REEDM-Predicted Ambient Air Concentration Increments During Aborted Launches, Concept B

CO	Maximum 8-hour average concentration increment (ppm)	NAAQS/FAAQS 8-hour average (ppm)
DIV-S	0.0007	9
DIV-M	NA	9
DIV-M+	0.0007	9
DIV-H	NA	9
NO_x	Maximum 30-minute average concentration increment (ppm)	OSHA PEL ceiling (ppm)
DIV-S	0.105	5
DIV-M	NA	5
DIV-M+	NA	5
DIV-H	NA	5
NH_3	Maximum 8-hour average concentration increment (ppm)	NAAQS/FAAQS 8-hour average (ppm)
DIV-S	0.041	50
DIV-M	0.002	50
DIV-M+	0.002	50
DIV-H	0.002	50
Hydrazine Compounds	Maximum 30-minute average concentration increment (ppm)	OSHA PEL ceiling (ppm)
DIV-S	0.009	1
DIV-M	0.0	1
DIV-M+	0.0	1
DIV-H	0.0	1
HCl	Peak puff concentration increment (ppm)	OSHA PEL ceiling (ppm)
DIV-M+	0.023	5

CO = carbon monoxide
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
FAAQS = Florida Ambient Air Quality Standards
HCl = hydrochloric acid
NA = not applicable
NAAQS = National Ambient Air Quality Standards
NH_3 = ammonia
NO_x = nitrogen oxides
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Level
REEDM = Rocket Exhaust Effluent Dispersion Model

Hydrazine compound concentrations were estimated by REEDM for each launch vehicle for the abort scenario when the upper stage fuels could be combusted. As discussed previously, there is no NAAQS or FAAQS for hydrazine; the OSHA PEL is shown for comparison, although it does not directly apply. The maximum concentrations of hydrazine compounds resulting from the use of the DIV-S with its HUS are larger than any of the other Concept B configurations.

Chlorine in the form of HCl was predicted for the DIV-M+ vehicles (commercial only). There is no NAAQS or FAAQS for HCl. For comparison purposes, the PEL is shown, although this limit is not directly applicable. Peak puff concentrations are a small fraction of the OSHA PEL ceiling limit. The largest concentrations occur under nominal launch conditions and are so small that they do not appear to pose any short-term health hazards.

Additional details and modeling results are presented in Appendix J. Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program.

Regional Air Quality Impacts

Regional impacts on the lower atmosphere are best summarized by totaling the emissions into the ROI associated with the program. Criteria pollutants are of concern for long-term impacts over the entire air quality region (Brevard County). Emissions from the launch itself were modeled using REEDM to determine local impacts. Other EELV-related air emissions are generally of longer duration, lower mass emission rate, and are spread over Cape Canaveral AS and the air quality region. Short-term criteria pollutant concentrations are therefore not of concern for launch support activities.

Annual emission rates would depend on the proposed launch schedule (see Table 2.1-8). Many of the emission-generating activities occur once per vehicle launch. Peak-year emissions are summarized in Table 4.10.15. Emission summaries for key years between 2001 and 2020 are presented in Appendix J.

Table 4.10-15. Emission Comparison, Concept B - Cape Canaveral AS[(a)]

	Emissions (in tons)[(b)]				
	VOC	NO_x	CO	SO_2	PM_{10}
Launches	0.0	15.1	0.0	0.0	37.2
Preparation, Assembly, and Fueling	15.2	0.0	0.0	0.0	2.8
Mobile Sources	10.1	23.0	73.2	1.0	61.7
Point Sources	0.5	4.2	1.1	0.4	0.1
Total	25.8	42.3	74.3	1.4	101.8
Brevard County 1995 Total (for comparison)	24,983	26,122	134,743	27,524	35,090

Note: (a) Includes emissions into the lower atmosphere (<3,000 feet) only.
(b) Emissions are based upon launch rates shown in Table 2.1-8 for the peak emission year at Cape Canaveral AS (2015).
AS = Air Station
CO = carbon monoxide
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

Peak-year operation emissions of criteria pollutants would not jeopardize the attainment status for these pollutants. Baseline emissions in Brevard County are below the levels that would cause nonattainment, and the peak-year operation emissions are only a small fraction of the county baseline. In addition, based on current emissions estimates, a reduction of emissions from the baseline for all criteria pollutants would occur under Concept B.

4.10.1.2.2 Concept B - Vandenberg AFB. Localized air quality impacts have been addressed for Vandenberg AFB in a manner similar to that described in Section 4.10.1.1.2. Because of the attainment status and regulatory framework at Vandenberg AFB, regional air quality impacts must be assessed using additional thresholds and criteria. As described in Section 4.10.1.1.2, an air conformity applicability analysis is required to determine if the total of direct and indirect emissions of a criteria pollutant in a nonattainment area caused by the federal action equals or exceeds de minimis thresholds (see Appendix K).

Changes associated with the EELV program would need to be documented in the ENVVEST reporting for Vandenberg AFB, as discussed for Concept A in Section 4.10.1.1.1. The Concept B contractor plans to use new boilers and heaters (NO_x sources) for this program. These new boilers and heaters will be installed and used for the EELV program; boilers and heaters associated with the current Atlas, Delta, and Titan programs will either no longer be used, or their usage will be reduced. The total estimated emissions of NO_x from the new point sources is 4.2 tons per year, as shown in Table 4.10-20. These emissions will replace the baseline emissions (emissions associated with the current Atlas, Delta, and Titan programs). The total estimated baseline emissions of NO_x from point sources is 8.1 tons, as shown in Table 3.10-9. Therefore, implementing the Concept B EELV program is expected to decrease NO_x emissions by 3.9 tons per year. Because total emissions are expected to decrease, the EELV activities are not likely to negatively impact implementation of the ENVVEST program.

Facility Construction

Emissions generated by facility construction activities are described in Sections 4.10.1.1.1 and 4.10.1.1.2.

Facility construction for Concept B operations at Vandenberg AFB would involve extensive renovation and some new construction at SLC-6. Construction would involve disturbing 49.7 acres within the SLC-6 fenceline over a 32-month period. Stripping, excavating, site clearing, backfill, and compaction are expected to take place on about 19 acres per year. Ultimately, a total of 337,675 square feet has been projected as requiring repaving. A combined total of 844,188 square feet of buildings and other structures would be constructed or renovated. Nearly all of the facilities construction would involve modifications to existing structures within the SLC-6 fenceline. Additional renovation would include work planned for Buildings 520, 838, 398, and 330 (all facilities remote to SLC-6).

All emissions of pollutants were developed using an approach identical to that used for Cape Canaveral AS and are included in Appendix J. Climatological parameters specific to the Los Angeles, California, area were used to reflect wind speed and rainfall days appropriate to the site.

In addition to emissions that are directly construction-related, there would be emissions associated with commuter traffic (see Section 4.10.1.1.1).

Measures to reduce emissions during the construction phase would be similar to those described for Cape Canaveral AS.

Local concentrations of criteria pollutants would increase during the construction phase, as described in Section 4.10.1.1.1 (Table 4.10-16).

Table 4.10-16. Construction-Related Emissions - Concept B, Vandenberg AFB Average Annual Emission Over Construction Period

Equipment	VOC	NO_x	CO	SO_2	PM_{10}
Grading Equipment (lbs/day)	5.1	32.9	7.1	2.2	5.8
Asphalt Paving (lbs/day)	0.8	0.0	0.0	0.0	0.0
Stationary Equipment (lbs/day)	58.7	47.9	10.4	3.2	2.8
Mobile Equipment (lbs/day)	55.9	562.4	559.3	26.1	41.9
Architectural Coatings (Non-Residential) (lbs/day)	48.2	0.0	0.0	0.0	0.0
Total Emissions (lbs/day):	168.7	643.2	576.7	31.5	50.5
Total Emissions (tpy):	19.4	74.0	66.3	3.6	5.8
Construction Commuter Automobiles (tpy)	1.3	1.2	15.6	0.1	5.4
Total activities (Construction and Commuter) (tpy)	20.7	75.2	81.9	3.7	11.2
Santa Barbara County 1995 Total (tpy, for comparison)	44,664	13,994	102,509	1,290	29,374

CO = carbon monoxide
lbs = pounds
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
tpy = tons per year
VOC = volatile organic compound

Dust from construction activities should have minimal impacts to local communities either on or off site, similar to those discussed for Concept A in Section 4.10.1.1.1.
The expected emissions of ozone precursors (VOC and NO_x) and PM_{10} from construction would be minimal compared with the county baseline. However, since the SCCAB is in non-attainment for ozone and PM_{10}, these emissions would still be mitigated to the extent feasible.

Construction emissions of SO_2, NO_x, and CO would not jeopardize the attainment status for these pollutants. Baseline emissions in the SCCAB are below levels that would cause nonattainment, and the peak-year construction emissions are only a small fraction of the county baseline.

According to SBCAPCD Rule 202, permits are not required for engines used in construction activities. However, if the combined emissions from all construction equipment used to construct a stationary source that requires a permit have the potential to exceed 25 tons per year of SO_2, NO_x, PM_{10}, or VOC, emissions offsets must be obtained, and the owner must demonstrate that no ambient air quality standard would be violated.

Operations

Pre- and Post-Launch Processing. Pre- and post-launch processing for Concept B operations at Vandenberg AFB would result in minor amounts of air emissions from activities similar to those discussed for Cape Canaveral AS in Section 4.10.1.1.1. Emissions of criteria pollutants could cause or contribute to the nonattainment of NAAQS or CAAQS for the region. Emissions of pollutants can also cause localized health effects.

Vehicle Preparation and Assembly. Procedures for vehicle preparation and assembly would be similar to those described in Section 4.10.1.1.2. Measures to reduce emissions during vehicle preparation and assembly would be similar to those discussed in Section 4.10.1.1.1.

Vehicle Fueling. Fueling of hydrogen for the CUS would be the same as described in Section 4.10.1.2.1.

Emissions from hydrazine and N_2O_4 loading would be controlled by a combination of sealed transfer systems and portable scrubbers. The loading of MMH used in the CUS would be controlled using an existing portable bubble-cap scrubber, which uses water and citric acid to trap hydrazine fuels. An existing portable scrubber similar to the oxidizer vapor scrubber system used for Titan IVB operations would be used to control the loading of N_2O_4 used in the CUS.

Emissions of hydrazine are listed as HAPs emissions. Emissions of N_2O_4 are minimal compared to other sources of nitrogen oxides. The wet scrubbing systems have been permitted by SBCAPCD, but have since been exempted from permitting requirements. If permits are necessary, these permits would need to be modified to reflect the change in operation.
After vehicle launch, the SLC must be cleaned and repaired, as described in Section 4.10.1.2.1.

Mobile Sources. Mobile sources of emissions would be the same as those described in Section 4.10.1.1.1.

Vehicle Deliveries. Concept B vehicle components would be delivered by truck, aircraft, barge, or rail. Truck emissions were calculated using pounds of emissions per VMT based on EMFAC 7f and PART5 emission factors; emissions from required escort cars for oversized loads were calculated similarly.

Because the ROI for Vandenberg AFB includes all of the SCCAB, transportation emissions were calculated for all vehicular traffic that would take place in Santa Barbara, San Luis Obispo, and Ventura counties directly related to the EELV program.

It is assumed that deliveries made by truck would involve round-trip traffic to and from the northern San Luis Obispo County line (50 percent) or the eastern Ventura County line (50 percent).

Emissions from aircraft and barge operations were calculated as described in Section 4.10.1.2.1.

Vehicle Assembly and On-Site Transport. Assembly of the vehicle components and on-site transport of the vehicle would involve emissions from mobile sources which were estimated as described in Section 4.10.1.1.2.

Personal Automobile Use and Miscellaneous Supply Traffic. Emissions from automobile use and supply traffic were calculated based on both on- and off-site emissions. It was assumed that each vehicle would travel once per day to and from one of the nearest major towns (Lompoc and Santa Maria). Emissions were calculated using vehicle miles traveled and the emission factors in the EMFAC 7f and PART5 computer models. A surge in automobile traffic prior to launch has been accounted for in the calculations.

Point Sources. Point sources would be the same as those described in Section 4.10.1.1.1. Some equipment currently at Vandenberg AFB would be used for the EELV program. Emissions were calculated as described in Section 4.10.1.1.2. Permitting for specific pieces of preparation and assembly equipment must be addressed under the SBCAPCD permitting requirements (Regulation II), and changes must be noted in the ENVVEST reporting.

The duration and magnitude of emissions associated with vehicle preparation and assembly are described in Section 4.10.1.1.1.
Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program. These impacts are addressed under Regional Air Quality Impacts and are summarized in Table 4.10-20.

Launch Activities

Launch Emissions. Vehicle launch emissions would occur as described in Section 4.10.1.1.1.

The chemicals of concern include the tropospheric criteria pollutants for which NAAQS apply (NO_x, and CO) and tropospheric precursors to ozone (NO_x and reactive VOCs). Table 4.10-17 summarizes the total mass of the various chemicals of concern released into the lower atmosphere from vehicle exhaust and after-burning during a LEO mission from Vandenberg AFB.

Table 4-10-17. Summary of Flight Emissions Deposited in the Lower Atmosphere, Concept B[(a)] (in tons)

Launch Vehicle	Particulate	NO_x	CO	HCl	VOC
DIV-S	0.0	0.37	0.0	0.0	0.0
DIV-M	0.0	0.37	0.0	0.0	0.0
DIV-M+	2.71	0.48	0.0	1.40	0.0
DIV-H	0.0	1.10	0.0	0.0	0.0

Note: (a) Assumes a low-Earth orbit mission.
CO = carbon monoxide
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
HCl = hydrochloric acid
NO_x = nitrogen oxides
VOC = volatile organic compound

Localized air quality impacts were assessed using the REEDM model as described in Section 4.10.1.1.1.

The CAAQS has an hourly NO_2 standard of 0.25 ppm. For conservative purposes, all NO in NO_x is assumed to convert to NO_2 rapidly. The REEDM-predicted NO_x ($NO + NO_2$) incremental concentrations resulting from the aborts of Concept B vehicles are summarized in Table 4.10-18.

Table 4.10-18. Summary of REEDM-Predicted Ambient Air Concentration Increments for NO_x During Nominal Launches, Concept B

	Peak Puff concentration increment (ppm)	CAAQS 1-hour average NO_2 standard (ppm)
DIV-S	0.102	5
DIV-M	0.109	5
DIV-M+	0.119	5
DIV-H	0.020	5

CAAQS = California Ambient Air Quality Standards
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
NO_2 = nitrogen dioxide
NO_x = nitrogen oxides
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

The predicted ambient concentrations of NO or NO_2 for nominal launches show the effects of the increased buoyancy due to the extreme heat release of the three boosters. Due to increased plume rise, the concentrations at the ground decrease significantly. The results indicate that in the worst case, the predicted NO_x concentration increment is a very small fraction of the OSHA PEL.

Launch Failure Emissions. Emissions from launch failures at Vandenberg AFB were estimated using the Aerospace fireball deflagration model (Brady et al., 1997) (Table 4.10-19). The mass emission rates calculated from Concept A launch failures are the same at Vandenberg AFB as those shown for Cape Canaveral AS in Section 4.10.1.2.1.

Table 4.10-19. Summary of REEDM-Predicted Ambient Air Concentration Increments for NO_x During Aborted Launches, Concept B

	Peak Puff concentration increment (ppm)	CAAQS 1-hour average NO_2 standard (ppm)
DIV-S	0.105	5
DIV-M	NA	5
DIV-M+	NA	5
DIV-H	NA	5

CAAQS = California Ambient Air Quality Standards
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
NA = not applicable
NO_2 = nitrogen dioxide
NO_x = nitrogen oxides
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

NO or NO_2 incremental concentrations during an abort were predicted by REEDM only for the DIV-S vehicle configuration.

Additional details and modeling results are presented in Appendix J. Regional impacts affecting maintenance of ambient air quality standards must be addressed in combination with other sections of the program.

Regional Air Quality Impacts

Cumulative impacts on the lower atmosphere are best summarized by totaling the emissions into the ROI associated with the program. Criteria pollutants are of concern for long-term impacts over the entire air quality region (SCCAB). Emissions from the launch itself were modeled using REEDM to determine local impacts. Other EELV-related air emissions would generally be of longer duration, lower mass emission rate, and are spread over Vandenberg AFB and the air quality region. Short-term criteria pollutant concentrations are therefore not of concern for launch support activities.

Annual emission rates depend on the proposed launch schedule (see Table 2.1-8). The complete emission summary for the years 2001 to 2020 is detailed in Appendix J. Peak emissions into the lower atmosphere at Vandenberg AFB would occur in 2007. The launch schedule and estimated emissions are presented in Table 4.10-20.

Table 4.10-20. Emission Comparison, Concept B - Vandenberg AFB[a]

	Emissions (in tons)[b]				
	VOC	NO_x	CO	SO_2	PM_{10}
Launches	0.0	5.4	0.0	0.0	5.4
Preparation, Assembly, and Fueling	6.6				1.2
Mobile Sources	6.7	10.8	83.9	0.5	78.0
Point Sources	0.5	4.2	1.1	0.4	0.1
Total	13.8	20.3	84.9	0.9	84.7
Santa Barbara County 1995 Total (for comparison)	44,664	13,994	102,509	1,290	29,374

Notes: (a) Includes emissions into the lower atmosphere (<3,000 feet) only.
(b) Emissions are based upon launch rates shown in Table 2.1-8 for the peak emissions year at Vandenberg AFB (2007).
CO = carbon monoxide
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

The expected emissions of ozone precursors (VOC and NO_x) and PM_{10} from peak-year operation are small compared with the county baseline. However, since the SCCAB is in nonattainment for ozone and PM_{10}, these emissions would still be mitigated to the extent feasible.

Peak-year operation emissions of SO_2, NO_x, and CO would not jeopardize the attainment status for these pollutants. Baseline emissions in the SCCAB are below the levels that would cause nonattainment, and the peak-year operation emissions are only a small fraction of the county baseline.

Based on current emissions estimates, Concept B would result in a reduction of emissions from the baseline for all criteria pollutants. The final system design would need to be compared with the permitting and regulatory requirements listed in Section 3.10 to determine required action.

Based on current stationary source emission estimates, and the current emissions estimates from ENVVEST source categories, it does not appear that installation of new stationary sources for Concept B would trigger new requirements under SBCAPCD Rule 1301. Vandenberg AFB will need to consider EELV operations when planning to meet ENVVEST emission reduction goals.

4.10.1.3 Concept A/B

Overall emission estimates were calculated as the sum of emissions from specific activities. Concept A/B emission estimates were calculated as the sum of emissions from the specific activities described for Concepts A and B in Sections 4.10.1.1 and 4.10.1.2, respectively.

4.10.1.3.1 Concept A/B - Cape Canaveral AS. Air quality impacts from Concept A/B would be similar to the combined effects described in Sections 4.10.1.1 and 4.10.1.2 for Concepts A and B, respectively.

Facility Construction

Under Concept A/B, the construction emissions described for Concept A in Section 4.10.1.1 and for Concept B in Section 4.10.1.2 would occur. Because the construction schedules would be staggered somewhat for the two concepts, and given that there is some flexibility in the construction schedules, it is difficult to predict the total average annual construction emissions for both concepts. Total construction emissions, roughly estimated as the sum of average annual emissions for Concepts A and B for VOCs, NO_x, CO, SO_2, and PM_{10} would be 36.0, 126.4, 134.5, 7.0, and 22.0 tons per year, respectively.

Operations

Emissions associated with Concept A/B operational activities would be the same for each launch vehicle as described for Concepts A and B in Section 4.10.1.1 and 4.10.1.2, respectively. Table 4.10-21 presents the emissions associated with Concept A/B operational activities, and reflects the sum of Concepts A and B emissions in the peak year.

Launch Activities

Launch emissions associated with Concept A/B for nominal and abort scenarios would be the same for each launch vehicle as described for Concepts A and B in Section 4.10.1.1 and 4.10.1.2, respectively (see Table 4.10-21).

Regional Air Quality Impacts

Regional impacts on the lower atmosphere include emissions associated with preparing and launching Concept A and Concept B vehicles. Criteria

Table 4.10-21. Emission Comparison, Concept A/B - Cape Canaveral AS[(a)]

	Emissions (in tons)[(b)]				
	VOC	NO_x	CO	SO_2	PM_{10}
Launches	0.0	21.4	0.0	0.0	16.8
Preparation, Assembly, and Fueling	19.1	0.0	0.0	0.0	5.9
Mobile Sources	12.0	29.8	88.2	1.2	78.2
Point Sources	0.8	8.7	2.0	0.6	0.4
Total	31.9	60.0	90.2	1.8	101.3
Brevard County 1995 Total (for comparison)	24,983	26,122	134,743	27,524	35,090

Notes: (a) Includes emissions into the lower atmosphere (<3,000 feet) only.
(b) Emissions are based upon launch rates shown in Table 2.1-11 for the peak emissions year at Cape Canaveral AS (2015).
AS = Air Station
CO = carbon monoxide
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

pollutants are of concern for long-term impacts over the entire air quality region (Brevard County).

Annual emission rates depend on the proposed launch schedule (see Table 2.1-11). The emission summary for key years between 2001 and 2020 is detailed in Appendix J. Peak emissions into the lower atmosphere at Cape Canaveral AS would occur during 2015 for Concept A/B (see Table 4.10-21).

Peak-year operation emissions of criteria pollutants would not jeopardize the attainment status for these pollutants. Baseline emissions in Brevard County are below the levels that would cause nonattainment and the peak-year operation emissions are only a small fraction of the county baseline. Also, based on current emissions estimates, Concept A/B would result in a reduction of emissions from the baseline for all criteria pollutants.

4.10.1.3.2 Concept A/B - Vandenberg AFB. Air quality impacts from Concept A/B would be similar to the combined effects described in Sections 4.10.1.1 and 4.10.1.2.

Changes associated with the EELV program would need to be documented in the ENVVEST reporting for Vandenberg AFB, as discussed for Concept A in Section 4.10.1.1.1. The Concept A contractor plans to use existing boilers and heaters (NO_x sources) for this program. The existing boilers and heaters will be used for the EELV program instead of their current uses. The Concept B contractor plans to use new boilers and heaters (NO_x sources) for this program. These new boilers and heaters will be installed and used for the EELV program. Boilers and heaters associated with the current Atlas, Delta, and Titan programs will either no longer be used or their usage will be reduced. The total estimated emissions of NO_x from the point sources associated with Concept A/B is 8.7 tons per year, as shown in Table 4.10-22. These emissions will replace the baseline emissions (emissions associated with the current Atlas, Delta, and Titan programs). The total estimated baseline emissions of NO_x from point sources is 8.1 tons, as shown in Table 3.10-9. Therefore, implementing the Concept A/B EELV program is expected to increase NO_x emissions by 0.6 tons per year. Based on the 1994 emissions summary shown in Appendix J, this increase would not be sufficient to cause any source group to exceed the Rule 1301 threshold of 25 tons of NO_x. Therefore, the EELV activities are not likely to negatively impact implementation of the ENVVEST program.

Table 4.10-22. Emission Comparison, Concept A/B - Vandenberg AFB[a]

	Emissions (in tons)[b]				
	VOC	NO_x	CO	SO_2	PM_{10}
Launches	0.0	7.9	0.0	0.0	10.8
Preparation, Assembly, and Fueling	9.9	0.0	0.0	0.0	1.1
Mobile Sources	6.8	11.7	86.1	0.6	87.1
Point Sources	0.8	8.7	2.0	0.6	0.4
Total	17.5	28.2	88.1	1.2	99.5
Brevard County 1995 Total (for comparison)	24,983	26,122	134,743	27,524	35,090

Notes: (a) Includes emissions into the lower atmosphere (<3,000 feet) only.
(b) Emissions are based upon launch rates shown in Table 2.1-11 for the peak emissions year at Vandenberg AB (2007).
CO = carbon monoxide
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

Facility Construction

For Concept A/B, construction for the facilities for both contractors would proceed. The construction emissions described for Concept A in Section 4.10.1.1.1 and for Concept B in Section 4.10.1.2.1 would occur. As part of the Air Conformity Applicability Analysis (see Appendix K), estimates of annual construction emissions were performed based on the proposed construction schedule.

Operations

Emissions associated with Concept A/B operational activities would be the same for each launch vehicle as described for Concepts A and B in Sections 4.10.1.1 and 4.10.1.2, respectively. Table 4.10-22 presents the emissions associated with Concept A/B operational activities, and reflects the sum of Concepts A and B emissions in the peak year.

Launch Activities

Launch emissions associated with Concept A/B for nominal and abort scenarios would be the same for each launch vehicle as described for Concepts A and B in Sections 4.10.1.1 and 4.10.1.2, respectively (see Table 4.10-22).
As discussed in Section 4.10.1.1.2, an air conformity applicability analysis for EELV activities is provided in Appendix K.

Regional Air Quality Impacts

Regional impacts on the lower atmosphere include emissions associated with preparing and launching Concept A and Concept B vehicles. Criteria pollutants are of concern for long-term impacts over the entire air quality region (SCCAB).

Annual emission rates depend on the proposed launch schedule (see Table 2.1-11). Emission summaries for key years between 2001 and 2020 are detailed in Appendix J. Peak emissions into the lower atmosphere at Vandenberg AFB would occur during 2007. The launch schedule and estimated emissions are presented in Table 4.10-22.

The expected emissions of ozone precursors (VOC and NO_x) and PM_{10} from peak-year operations would be minimal compared with the county baseline. However, since the SCCAB is in nonattainment for ozone and PM_{10} for state standards, these emissions would still be mitigated to the extent feasible.

Peak-year operation emissions of SO_2, NO_x, and CO would not be sufficient to jeopardize the attainment status for these pollutants. Baseline emissions in the SCCAB are below the levels that would cause nonattainment, and the peak-year operation emissions would be only a small fraction of the county baseline.

Based on current emissions estimates, Concept A/B would result in a reduction of emissions from the baseline for all criteria pollutants. The final system design would need to be compared with the permitting and regulatory requirements listed in Section 3.10 to determine required action.

4.10.2 No-Action Alternative

Emissions associated with the No-Action Alternative would be those associated with continued use of the Atlas, Delta, and Titan vehicles to meet the government portion of the NMM. Operations would continue as described in Section 3.10. The calculations in this section assume the use of Atlas IIA, Delta II, and Titan IVB vehicles.

Air quality impacts and health effects would be similar to those associated with the Proposed Action. In addition to the chemicals of concern associated with the Proposed Action, ODSs used as part of the degreasing operations for the No-Action Alternative have the potential to damage the stratospheric ozone layer. Damage to the stratospheric ozone layer can cause health hazards in the form of increased skin cancer rates.

Air quality impacts from No-Action Alternative operations would result from the general sources described in Section 4.10.1. Deliveries of vehicle components occur by truck and aircraft; emissions from both forms of delivery have been calculated and compared to existing mobile source emissions. Fuels used in the No-Action Alternative vehicles include kerosene fuel (RP-1), cryogenic gases (LO_2 and LH_2), hydrazines (MMH, A-50, and N_2H_4), N_2O_4, and solid rocket fuels. Emissions from the handling and storage of these fuels have been calculated and compared to existing emissions.

4.10.2.1 Cape Canaveral AS. Emissions from the No-Action Alternative would occur from the following sources: vehicle launch; vehicle preparation, assembly, and fueling; mobile sources such as support equipment, commercial transport vehicles (including trucks and aircraft), and personal vehicles; and point sources such as heating/power plants, generators, incinerators and storage tanks.

Estimates were divided into two categories: emissions that are directly launch-related and infrastructure emissions. Launch-related emissions were estimated on a pounds-per-launch basis; infrastructure emissions were estimated on a pounds-per-day basis and were assumed to take place regardless of the number of launches conducted per year.

Emissions were calculated using the methods and assumptions used to calculate the baseline emissions described in Section 3.10. In addition to the emissions from refrigeration units (ODSs), fire suppression and some degreasing operations would also produce emissions. Total ODS emissions associated with the Atlas, Delta, and Titan operations are difficult to estimate for the No-Action Alternative at Cape Canaveral AS because of ongoing efforts to reduce or eliminate the use of ODSs. Depending on the success of these efforts, ODS emissions may be zero.

Emissions from pre- and post-launch processing include criteria pollutants and toxic or irritant pollutants (including HAPs). Emissions of criteria pollutants could cause or contribute to the nonattainment of NAAQS or FAAQS for the region. Emissions of pollutants can also cause localized health effects.

Launch emissions and their associated impacts would be similar to those associated with baseline activities (see Section 3.10).

For comparison purposes, localized air quality impacts were assessed using the REEDM model, as described for Concepts A and B in Sections 4.10.1.1.1 and 4.10.1.2.1, respectively. Titan and Delta launches were modeled, and results for nominal scenarios are presented in Tables 4.10-23 and 4.10-24, respectively.

Table 4.10-23. Summary of REEDM-Predicted Ambient Air Concentration Increments During Nominal Launches (Titan IV and Delta II)

CO	Maximum 8-hour average concentration increment (ppm)	NAAQS 8-hour average (ppm)
Titan IVB-A	0.14	9
Delta II-7925	0.69	9
NO_x	Maximum 8-hour average concentration increment (ppm)	CAAQS NO_2 1 hour average (ppm)
Titan IVB-A	0.07	0.25
Delta II-7925	0.01	0.25
HCl	Peak puff concentration increment (ppm)	OSHA PEL ceiling (ppm)
Titan IVB-A	3.32	5
Delta II-7925	1.43	5

CAAQS = California Ambient Air Quality Standards
CO = carbon monoxide
HCl = hydrochloric acid
NAAQS = National Ambient Air Quality Standards
NO_2 = nitrogen dioxide
NO_x = nitrogen oxides
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Level
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

Table 4.10-24. Summary of REEDM-Predicted Ambient Air Concentration Increments During Aborted Launches (Titan IV and Delta II)

CO	Maximum 8-hour average concentration increment (ppm)	NAAQS 8-hour average (ppm)
Titan IVB-A	0.86	9
Delta II-7925	2.07	9
NO_x	Maximum 8-hour average concentration increment (ppm)	CAAQS NO_2 1-hour average (ppm)
Titan IVB-A	4.18	0.25
Delta II-7925	0.17	0.25
NH_3	Maximum 8-hour average concentration increment (ppm)	OSHA PEL 8-hour average (ppm)
Titan IVB-A	1.58	50
Delta II-7925	0.07	50
Hydrazine Compounds	Maximum 8-hour average concentration increment (ppm)	OSHA PEL 8-hour average (ppm)
Titan IVB-A	0.27	1
Delta II-7925	0.01	1
HCl	Peak puff concentration increment (ppm)	OSHA PEL ceiling (ppm)
Titan IVB-A	0.84	5
Delta II-7925	0.26	5

CAAQS = California Ambient Air Quality Standards
CO = carbon monoxide
HCl = hydrochloric acid
NAAQS = National Ambient Air Quality Standards
NO_2 = nitrogen dioxide
NO_x = nitrogen oxides
OSHA = Occupational Safety and Health Administration
PEL = Permissible Exposure Level
ppm = parts per million
REEDM = Rocket Exhaust Effluent Dispersion Model

As with the Proposed Action, impacts from the No-Action Alternative on the lower atmosphere are best summarized by totaling the emissions into the ROI associated with the program. Annual emission rates would depend on the proposed launch schedule. Many of the emission-generating activities would occur once per vehicle launch. A No-Action Alternative launch schedule for 2001 through 2020 based on the government portion of the NMM was developed. The peak NO_x emissions would occur during 2015. Emissions are summarized for 2015 in Table 4.10-25.

Table 4.10-25. No-Action Alternative Emission Comparison, Cape Canaveral AS[a]

	Emissions (in tons)[b]				
	VOC	NO_x	CO	SO_2	PM_{10}
Launches	0	7.5	0	0	59.2
Preparation, Assembly, and Fueling	8.9	0	0	0	3.6
Mobile Sources	24.8	62.0	213.7	2.7	122.8
Point Sources	1.0	22.9	6.2	17.7	1.0
Total	34.6	92.3	220.0	20.4	186.6
Brevard County 1995 Total (for comparison)	24,983	26,122	134,743	27,524	35,090

Notes: (a) Includes emissions into the lower atmosphere (<3,000 feet) only.
(b) Emissions are based upon launch rates shown in Appendix J for the peak emissions year at Vandenberg AB (2007).
CO = carbon monoxide
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

It is important to note that the launch schedule developed for the No-Action Alternative does not include any commercial launches. For this reason, there are fewer launches per year shown for the No-Action Alternative than for the Proposed Action.

Emissions of several chemicals of concern into the lower atmosphere in the peak years for each of the launch concepts are presented in Table 4.10-26 for Cape Canaveral AS.

Table 4.10-26. Lower Atmosphere Launch Emissions, Cape Canaveral AS (2015)

	Number of launches	Tons/Year NO_x	PM_{10}	HCl
Concept A	23	18.5	0.0	0.0
Concept B	23	15.1	25.1	13.0
Concept A/B	26	21.4	16.8	8.6
No-Action Alternative[a]	11	7.5	59.2	29.9

Note: (a) Government launches only.
HCl = hydrochloric acid
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter

The EELV program concepts are considerably cleaner in terms of the particulate and chlorine loading than those of the No-Action Alternative. The No-Action Alternative vehicles seem to produce less NO_x emissions than the EELV systems, but this is due to the large difference in the number of launches between the Proposed Action and No-Action Alternative. Although the No-Action Alternative includes fewer launches than the Proposed Action, it would produce more PM_{10} and HCl emissions.

Vandenberg AFB. Emissions from the No-Action Alternative would be similar to those described in Section 4.10.2.1. Although the No-Action Alternative includes fewer launches than the Proposed Action, it would produce more PM_{10} and HCl emissions.

Emissions were calculated using the methods and assumptions used to calculate the baseline emissions described in Sections 3.10 and 4.10.2.1. Launch emissions and their associated impacts would be similar to those associated with baseline activities described in Section 3.10.

As with the Proposed Action, impacts from the No-Action Alternative on the lower atmosphere are best summarized by totaling the emissions into the ROI associated with the program (Table 4.10-27). The peak year is defined as the year with the highest predicted NO_x emissions, not the year with the most launches.

Table 4.10-27. No-Action Alternative Emission Comparison, Vandenberg AFB[(a)]

	Emissions (in tons)[(b)]				
	VOC	NO_x	CO	SO_2	PM_{10}
Launches	0.0	2.4	0.0	0.0	34.9
Preparation, Assembly, and Fueling	3.4	0.0	0.0	0.0	1.3
Mobile Sources	8.7	15.2	117.2	0.8	103.8
Point Sources	0.2	8.1	1.2	0.6	0.5
Total	12.3	25.7	118.4	1.4	140.5
Santa Barbara County 1995 Total (for comparison)	44,664	13,994	102,509	1,290	29,374

Notes: (a) Government launches only.
(b) Includes emissions into the lower atmosphere (<3,000 feet) only.
AFB = Air Force Base
CO = carbon monoxide
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter
SO_2 = sulfur dioxide
VOC = volatile organic compound

Emissions of several chemicals of concern into the lower atmosphere in the peak years for each of the launch concepts are presented in Table 4.10-28 for Vandenberg AFB launches.

Table 4.10-28. Lower Atmosphere Launch Emissions, Vandenberg AFB

	Peak Year	Number of launches	Tons/Year NO_x	Tons/Year PM_{10}	Tons/Year HCl
Concept A	2007	10	4.8	0.0	0.0
Concept B	2007	10	5.4	5.4	2.8
Concept A/B	2007	14	7.9	10.8	5.6
No-Action Alternative[a]	2008	4	2.4	34.9	17.6

Note: (a) Government launches only.
AFB = Air Force Base
HCl = hydrochloric acid
NO_x = nitrogen oxides
PM_{10} = particulate matter equal to or less than 10 microns in diameter

The Proposed Action is considerably cleaner in terms of particulates and chlorine loading than the No-Action Alternative. The No-Action Alternative does seem to produce less NO_x emissions than the Proposed Action, but this is due to the large difference in the number of launches between the alternatives. Although the No-Action Alternative includes fewer launches than the Proposed Action, it would produce more PM_{10} and HCl emissions.

4.11 AIR QUALITY (UPPER ATMOSPHERE)

Emissions into the upper atmosphere are not subject to any specific regulatory requirements. The upper atmosphere ROI consists of the upper troposphere, where weather systems can mix and remove pollutants after a few days to a few weeks, and the stratosphere, where the emissions are removed very slowly and can circle the earth. In the stratosphere, ODSs, including NO_x, Cl_x, and alumina particles, are the primary chemicals of concern.

4.11.1 Proposed Action

This section addresses potential impacts to the upper atmosphere associated with implementation of the EELV program. Because the upper atmosphere is common to both Cape Canaveral AS and Vandenberg AFB, the discussion focuses upon impacts related to implementation of Concept A, Concept B, and Concept A/B.

4.11.1.1 Concept A. Concept A launch vehicles would use a booster that burns RP-1 and LO_2. The composition of the after-burning emissions is very similar to that of the Atlas II core engine. There are four Concept A configurations that are distinguished by the type of upper stage and by the number of boosters strapped together (see Section 2.1.1). The boosters burn until they are well above the stratosphere, and no upper-stage emissions are emitted into the stratosphere.

Two flight trajectories (LEO and GTO) were used to estimate the amount of booster mass emitted into the lower atmosphere (0 to 3,000 feet) and the upper atmosphere (3,000 to 164,000 feet). The upper atmosphere ROI was divided into the three layers; the time of travel for each trajectory to pass through each layer is summarized in Table 4.11-1.

Table 4.11-1. Description of Flight Trajectories Used to Estimate the Fraction of Engine Burn Time in Atmospheric Layers

Layer Designation	Layer Top Elevation (feet)	Trajectory 1 (GTO) (seconds)	Trajectory 2 (LEO) (seconds)
Lower Atmosphere	3,000	29	19
Lower Troposphere	10,000	50	33
Upper Troposphere	49,000	95	72
Stratosphere	164,000	173	155

GTO = geosynchronous transfer orbit
LEO = low-Earth orbit

Table 4.11-2 summarizes the total mass of the various ODSs that would be released into the upper atmosphere from vehicle exhaust and after-burning during a GTO mission. This table shows that, in the troposphere, the only ODS emitted in any substantial amount would be NO_x. In the stratosphere, the only pollutant emitted is CO from carbon in the burned RP-1 fuel. In the stratosphere, however, the influence of CO on the upper-air chemistry is marginal; consequently, CO is not considered an effective ODS.

The emission rates were estimated for each year, and the year of peak NO_x emissions for the upper atmosphere was selected. The emission rates peaked for the year 2015 for Cape Canaveral AS and for 2014 for Vandenberg AFB. For estimation purposes, it was assumed that all Cape Canaveral AS launches would be GTO missions and that all Vandenberg AFB launches would be LEO missions. The peak annual launch emissions for the upper atmosphere and the stratosphere (Table 4.11-3) were calculated as the sum of using the emissions per vehicle flight (Table 4.11-2).

Concept A launches would produce no emissions into the stratosphere of any effective ODSs, and would therefore not cause any degradation of the stratospheric ozone layer.

Table 4.11-2. Summary of Flight Emissions into Upper Atmospheric Layers, Concept A[a] (in tons)

Atmosphere Layer	Particulate	NO_x	CO	Cl_x
	MLV-A (CUS)			
Lower Troposphere	0.0	0.28	0.0	0.0
Upper Troposphere	0.0	0.50	1.00	0.0
Stratosphere	0.0	0.0	58.47	0.0
	MLV-D (SUS)			
Lower Troposphere	0.0	0.28	0.0	0.0
Upper Troposphere	0.0	0.50	1.00	0.0
Stratosphere	0.0	0.0	58.47	0.0
	HLV-L (SUS)			
Lower Troposphere	0.0	0.83	0.0	0.0
Upper Troposphere	0.0	1.50	3.01	0.0
Stratosphere	0.0	0.0	175.42	0.0
	HLV-G (CUS)			
Lower Troposphere	0.0	0.83	0.0	0.0
Upper Troposphere	0.0	1.50	3.01	0.0
Stratosphere	0.0	0.0	175.42	0.0

Note: (a) Assumes a geosynchronous transfer orbit mission.
Cl_x = chlorine compounds
CO = carbon monoxide
CUS = Cryogenic Upper Stage
HLV = heavy lift variant
MLV = medium lift variant
NO_x = nitrogen oxides
SUS = Storable Upper Stage

Table 4.11-3. Summary of ODS Emissions, Concept A (tons per year)[a]

ODS	Upper Atmosphere (>49,000 feet)	Stratosphere (49,000 to 164,000 feet)
Particulates	0	0
Cl_x	0	0
NO_x	22.9	0
CO	1,893	1,862

Note: (a) Emissions are based upon launch rates shown in Table 2.1-3 for peak emission years at each installation (2015 at Cape Canaveral AS, 2014 at Vandenberg AFB).
Cl_x = chlorine compounds
CO = carbon monoxide
NO_x = nitrogen oxides
ODS = ozone-depleting substance

4.11.1.2 Concept B. Concept B launch vehicles would use a booster that burns LH_2 and LO_2. The composition of the after-burning emissions is very clean, essentially resulting in only water, unburned fuel, and oxy-hydrogen radicals. There are five Concept B configurations that are distinguished by the type of upper stage and by the number and type of boosters strapped together (see Section 2.1.2). The boosters would burn until they are well above the stratosphere and no upper-stage emissions are emitted into the stratosphere. The flight trajectories modeled were the same as those described in Section 4.11.1.1 for Concept A (see Table 4.11-1).

The ODSs include NO_x, alumina particles, and Cl_x. CO is also tracked, but its role in the upper atmospheric chemistry is so small that it is not considered an effective ODS. Table 4.11-4 summarizes the total mass of the various ODSs released into the atmosphere from vehicle exhaust and after-burning during a GTO mission.

Table 4.11-4. Summary of Flight Emissions into Upper Atmospheric Layers, Concept B[(a)] (in tons)

Atmosphere layer	Particulate	NO_x	CO	Cl_x
		DIV-S (HUS)		
Lower Troposphere	0.0	0.21	0.0	0.0
Upper Troposphere	0.0	0.38	0.0	0.0
Stratosphere	0.0	0.0	0.0	0.0
		DIV-M (CUS)		
Lower Troposphere	0.0	0.21	0.0	0.0
Upper Troposphere	0.0	0.38	0.0	0.0
Stratosphere	0.0	0.0	0.0	0.0
		DIV-M+ (CUS)		
Lower Troposphere	2.02	0.21	0.0	1.04
Upper Troposphere	8.34	0.47	0.33	4.30
Stratosphere	14.03	0.0	9.49	7.33
		DIV-H (CUS)		
Lower Troposphere	0.0	0.63	0.0	0.0
Upper Troposphere	0.0	1.14	0.0	0.0
Stratosphere	0.0	0.0	0.0	0.0

Note: (a) Assumes a low-Earth orbit mission.
Cl_x = chlorine compounds
CO = carbon monoxide
CUS = Cryogenic Upper Stage
DIV-H = heavy launch vehicle
DIV-M = medium launch vehicle
DIV-M+ = medium launch vehicle with solid rocket motor strap-ons
DIV-S = small launch vehicle
HUS = Hypergolic Upper Stage
NO_x = nitrogen oxides

In the troposphere, the only ODS deposited from configurations with no strap-on solid rocket motors in any substantial amount is NO_x (see Table 4.11-4). The stratospheric ODS emissions come only from configurations that use strap-on solid rocket motors.

The emission rates were estimated for each year, and the year of peak NO_x emissions for the upper atmosphere was selected. The emission rates peaked in the year 2015 for Cape Canaveral AS and in 2008 for Vandenberg AFB. For estimation purposes, it was assumed that all Cape Canaveral AS launches would be GTO missions and that all Vandenberg AFB launches would be LEO missions. The peak annual emissions for each upper atmospheric layer from all Concept B launches (Table 4.11-5) were estimated as the sum of the emissions per vehicle flight (see Table 4.11-4).

Table 4.11-5. Summary of ODS Emissions, Concept B (tons per year)[(a)]

ODS	Upper Atmosphere (>49,000 feet)	Stratosphere (49,000 to 164,000 feet)
Particulates	162.3	85.1
Cl_x	83.6	43.8
NO_x	22.7	0.0
CO	58.6	56.7

Note: (a) Emissions are based upon launch rates shown in Table 2.1-8 for peak emission years at each installation (2015 at Cape Canaveral AS, 2008 at Vandenberg AFB).

Cl_x = chlorine compounds
CO = carbon monoxide
NO_x = nitrogen oxides
ODS = ozone-depleting substance

Concept B government launch vehicles would not release ODSs into the stratosphere; however, the DIV-M+ (commercial only) launches would add ODSs. The projected emission rates are smaller than the baseline launch emissions described in Section 3.11. Even with commercial launches, Concept B would result in reductions of ODSs in the stratosphere from the current launch vehicles.

4.11.1.3 Concept A/B. Under Concept A/B, both Concept A and Concept B vehicles would be developed and launched. For analysis purposes, a nearly exact division of the Concept A and B launch rates has been assumed for each vehicle type (see Table 2.1-11). Concept A and B ODS emissions are described in Sections 4.11.1.1 and 4.11.1.2, respectively. The flight trajectories used to estimate the amount of booster mass emitted into atmosphere are summarized in Table 4.11-1.

The emission rates were estimated for each year, and the year of peak NO_x emissions for the upper atmosphere was selected. The emission rates peaked in the year 2015 for Cape Canaveral AS and in 2007 for Vandenberg AFB.

The same assumption regarding use of LEO and GTO trajectories at each installation was utilized. The peak annual emissions for each upper atmospheric layer from all launches (Table 4.11-6) were estimated as the sum of the emissions per vehicle flight (see Tables 4.11-2 and 4.11-4).

Concept A/B launches would discharge emissions of alumina particulates and Cl_x into the stratosphere as a result of using solid rocket motors for Concept B commercial launches. However, as discussed in Section

Table 4.11-6. Summary of ODS Emissions, Concept A/B (tons per year)[a]

ODS	Upper Atmosphere (<49,000 feet)	Stratosphere (49,000 to 164,000 feet)
Particulates[b]	157.0	84.7
Cl_x	80.9	43.7
NO_x	32.3	0.0
CO	1359.4	1337.1

Notes: (a) Emissions are based upon launch rates shown in Table 2.1-11 for peak emission years at each installation (2015 at Cape Canaveral AS, 2007 at Vandenberg AFB).
(b) Concept B commercial launches only.
Cl_x = chlorine compounds
CO = carbon monoxide
NO_x = nitrogen oxides
ODS = ozone-depleting substance

4.11.1.2, Concept A/B launches would result in reductions of ODSs in the stratosphere from current launch systems.

4.11.2 No-Action Alternative

Emissions from the government component of launches based on the NMM were estimated assuming continuation of existing launch programs (Atlas IIA, Delta II, Titan IVB). The annual launch schedule is presented in Appendix J. The tropospheric NO_x emissions were used to determine the peak years for emissions. Peak NO_x emissions would occur in 2015 for Cape Canaveral AS and in 2008 for Vandenberg AFB. No-Action Alternative emissions for the upper atmosphere and the stratosphere are provided in Table 4.11-7. Emissions of alumina particulates and chlorine from the No-Action Alternative launches would be greater than the estimated emissions for Concepts A and B, or for Concept A/B.

Table 4.11-7. Summary of the Annual Emissions Resulting from the No-Action Alternative (in tons)

	Cape Canaveral AS (2015)		Vandenberg AFB (2008)	
Pollutant	Upper Atmosphere	Stratosphere	Upper Atmosphere	Stratosphere
Particulates	368.2	174.1	296.1	162.7
NO_x	10.9	0.6	5.2	0.6
CO	527.3	516.0	227.4	222.7
Cl_x	185.3	87.5	148.7	81.6

Cl_x = chlorine compounds
CO = carbon monoxide
NO_x = nitrogen oxides

4.12 NOISE

Potential impacts due to noise and sonic boom exposure are discussed in this section. The potential impacts on wildlife are described in Section 4.14, Biological Resources.

4.12.1 Proposed Action

The proposed EELV system has not yet been launched; consequently, actual vehicle noise measurements are not available. Launch and ascent noise were computed by the RNOISE model recently developed for launch vehicle analysis (Plotkin et al., 1997) (see Appendix F). Sonic booms were computed using the U.S. Air Force PCBoom3 model (Plotkin, 1996) (see Appendix F).

4.12.1.1 Concept A

Noise analysis was performed for two vehicles (one three-engine heavy and one single-engine medium) at Cape Canaveral AS and Vandenberg AFB. The selected missions analyzed include: HLV-G (94-degree azimuth) and MLV-D (92-degree azimuth) at Cape Canaveral AS and HLV-L (181-degree azimuth), MLV-D (181-degree azimuth), MLV-A (158-degree azimuth), and MLV-A (186-degree azimuth) at Vandenberg AFB. Three medium vehicle launches were analyzed for Vandenberg AFB so as to assess the difference between various missions of the same vehicle type.

It was found that the noise and sonic boom footprints for the medium vehicles were similar among the missions analyzed, differing primarily according to the launch azimuth. The footprint from one mission can be approximated by that from another simply by rotating it to the corresponding azimuth. Launch direction is more important for sonic boom, with its crescent-shaped footprints, than for rocket noise, for which the highest level contours are approximately circular. In the following analysis, noise contours are shown for one heavy and one medium vehicle launch at each site. The effect of other launch azimuths is discussed.

The peak year launch rates for Concept A (see Table 2.1-3) are 22 per year from Cape Canaveral and 10 per year from Vandenberg. These are considerably less than one per day, the rate at which cumulative program noise metrics such as L_{dn} are meaningful. The following analysis of impacts, therefore, concentrates on single launch events.

4.12.1.1.1 Concept A, Cape Canaveral AS

In-Flight Rocket Noise. Figure 4.12-1 shows the in-flight maximum A-weighted noise level contours for the HLV-G. Figure 4.12-2 shows in-flight maximum A-weighted noise level contours for the MLV-D. Contours for other medium vehicles are similar to those shown in Figure 4.12-2. Sound levels for the medium vehicle are about 5 dB lower than for the heavy vehicle. Heavy vehicles represent approximately 2 percent of the projected Concept A launches. Conservative estimates of impact can be made by examining levels from the louder heavy vehicle.

The maximum A-weighted levels for the HLV-G in the nearest residential communities would be in the 75-dB range. This is somewhat louder than the noise of a passing automobile (65 to 70 dBA) and less than that of a passing heavy truck (80 to 85 dBA). Occasional sounds of this level will not cause adverse impact. SEL has been computed for this launch and is about 13 dB higher than the AWSPL. This corresponds to an effective duration of about 20 seconds. Launch noise is likely to be audible for a longer period, but the total time involved is not great enough to cause substantial impact.

Figure 4.12-3 shows the OSPL for the HLV-G. The higher-level contours are approximately circular, so launch azimuth is not important. OSPL in excess of 110 dB, which could cause structural damage claims at a rate of one per 1,000 households, is limited to a radius of approximately 3.3 miles from the launch site. This area does not contain residential communities, and most of the land area affected is within Cape Canaveral AS and KSC. The OSPL at the nearest residential communities, 8 to 10 miles away, would be below 100 dB, where structural damage, if any, would occur at a negligible rate.

The majority of missions (98 percent) would utilize medium and small vehicles, for which noise is about 5 dB lower and correspondingly less intrusive.

Sonic Boom. Figure 4.12-4 shows the sonic boom footprint for the HLV-G, and Figure 4.12-5 shows the footprint for the MLV-D. These two footprints are drawn to scale, and the highest level contours in the focal zones (6 to 7 psf) are too small to be seen in the figures. The lowest contour value drawn, 0.5 psf, is larger for the heavy vehicle, and its maximum overpressure is slightly higher, but otherwise the footprints are fairly similar.

Both of these footprints are aligned with the launch azimuths (94 degrees and 92 degrees, respectively) and fall in the Atlantic Ocean, well offshore. Most Concept A launches would be at azimuths between 91 and 97 degrees, and would not be substantially different from those shown in Figures 4.12-4 and 4.12-5. Some launches would be at an azimuth of 64 degrees. The footprint would fall farther to the north but would still be entirely over the Atlantic Ocean.

Figure 4.12-1 Maximum A-Weighted Sound Pressure Level, HLV-G, Cape Canaveral AS

Figure 4.12-2 Maximum A-Weighted Sound Pressure Level, MLV-D, Cape Canaveral AS

Figure 4.12-3 Maximum Overall Sound Pressure Level, HLV-G, Cape Canaveral AS

Figure 4.12-4 Sonic Boom Footprint, HLV-G, Cape Canaveral AS

Figure 4.12-5 Sonic Boom Footprint, MLV-D, Cape Canaveral AS

Most of the boom footprints are below 1 psf, a level at which no adverse effects would be expected, even over land, from an occasional sonic boom. The maximum focus overpressures are in the 6- to 8-psf range. This is comparable to the focus boom overpressures routinely generated by military aircraft during supersonic training missions over both land and water (Plotkin et al., 1993), and similar to focus boom overpressures generated by other launch vehicles (Downing et al, 1996). Since the entire boom footprint is over water, the only potential impacts would be to wildlife (see Section 4.14, Biological Resources).

Cumulative program noise impacts would be quantified by L_{dn} which has been computed for the busiest years. Values are about 50 dB lower than the AWSPL values shown in Figures 4.12-4 and 4.12-5. This is well within acceptable criteria for any type of land use. However, L_{dn} is not meaningful for events as infrequent as EELV launches, so the primary impact assessment is the single-event analysis presented above.

4.12.1.1.2 Concept A, Vandenberg AFB

In-Flight Rocket Noise. Figures 4.12-6 and 4.12-7 show the in-flight maximum AWSPL for the HLV-L and MLV-D. These contours are very similar to the corresponding contours at Cape Canaveral AS, differing primarily in location and alignment with the launch trajectory. Contours for the MLV-D are approximately 5 dB lower than those for the heavy vehicle.

Considering the HLV-L (less than 1 percent of Vandenberg AFB launches would be heavy vehicles), maximum A-weighted levels in the nearest residential communities would be in the 80- to 85-dB range (see Figure 4.12-6). This is comparable to the noise of a passing heavy truck (80 to 85 dBA). Occasional sounds of this level will not cause adverse impacts. SEL has been computed for this launch, and is about 13 dB higher than the AWSPL. This corresponds to an effective duration of about 20 seconds. Launch noise is likely to be audible for a longer period, but the total time involved is not great enough to cause substantial impact.

Figure 4.12-8 shows OSPL for the HLV-L. OSPL in excess of 110 dB, which could cause structural damage claims at a rate of one per 1,000 households, is limited to a radius of approximately 3.3 miles from the launch site. This area does not contain residential communities, and almost all of the land area affected is within Vandenberg AFB. The OSPL at the nearest residential community, Lompoc, about 8 miles away, would be below 100 dB, where structural damage, if any, would occur at a negligible rate.

The majority of missions (99 percent) would utilize medium and small vehicles, for which noise is about 5 dB lower and correspondingly less intrusive.

Figure 4.12-6 Maximum A-Weighted Sound Pressure Level, HLV-L, Vandenberg AFB

Figure 4.12-7 Maximum A-Weighted Sound Pressure Level, MLV-D, Vandenberg AFB

Figure 4.12-8 Maximum Overall Sound Pressure Level, HLV-L, Vandenberg AFB

Sonic Boom. Figures 4.12-9 and 4.12-10 show the sonic boom footprints for the HLV-L and MLV-D, respectively. The boom footprints are offshore, in the Pacific Ocean. The footprints are similar to each other (HLV-L is slightly larger than MLV-D), differing primarily in position and orientation along the launch azimuth. The maximum overpressures, in the narrow focal zones, are in the 6- to 8-psf range. Impacts are expected to be minimal.

The two boom footprints shown intersect the Channel Islands, with this intersection being at or near the focal zone. Potential impacts to wildlife are discussed in Section 4.14, Biological Resources.

The two missions shown are at launch azimuth of 181 degrees. Most Concept A launches from Vandenberg AFB would be at azimuths from 174 to 187 degrees, and sonic boom footprints would occur in similar regions. However, 23 percent of Concept A launches would utilize a 142-degree azimuth which is closer to the coast (Figure 4.12-11). The boom footprint intercepts the California coastline. Booms near the shore would be in the 0.5- to 2.0-psf range; booms farther inland would be smaller. The boom amplitudes are comparable to those associated with space shuttle landings at Edwards AFB, but the area is considerably smaller. Because of the small amplitude of the booms, and their infrequent occurrence (about twice a year during peak years), no adverse effects are expected.

Cumulative program noise impacts would be quantified by L_{dn} which has been computed for the busiest years. Values are about 50 dB lower than the AWSPL values seen in Figures 4.12-6 and 4.12-7. As discussed in Section 4.12.1.1.1, this is well within acceptable criteria for any type of land use.

4.12.1.2 Concept B

Noise analysis was performed for two vehicles (one three-engine heavy and one single-engine medium) at Cape Canaveral AS and Vandenberg AFB, and one medium-plus vehicle at Cape Canaveral AS. The selected missions analyzed include: DIV-H (95-degree azimuth), DIV-M+ (95-degree-azimuth), DIV-S (65-degree azimuth) at Cape Canaveral AS and DIV-H (184-degree azimuth) and DIV-M (170-degree azimuth) at Vandenberg AFB.

Noise and sonic boom footprints for the medium vehicles were similar among the missions analyzed, differing primarily according to launch azimuth and location. The results for the specific missions analyzed can be applied to other missions with the same vehicle sizes.

The peak-year launch rates for Concept B (see Table 2.1-8) are 23 per year from Cape Canaveral and 10 per year from Vandenberg. These are considerably less than one per day, the rate at which cumulative program noise metrics such as L_{dn}, are meaningful. The following analysis of impacts, therefore, concentrates on single launch events.

Figure 4.12-9 Sonic Boom Footprint, HLV-L, Vandenberg AFB

Figure 4.12-10 Sonic Boom Footprint, MLV-D, Vandenberg AFB

EXPLANATION

- - - - Base Boundary

psf Pounds per square foot

SLC Space Launch Complex

Vandenberg AFB

Sonic Boom Footprint, MLV-A, Vandenberg AFB

Figure 4.12-11

EELV077

4.12.1.2.1 Concept B, Cape Canaveral AS

In-Flight Rocket Noise. Figures 4.12-12, 4.12-13, and 4.12-14 show the in-flight maximum A-weighted noise level contours for the three Cape Canaveral AS missions analyzed: heavy, medium-plus, and medium vehicles, respectively. There is slight distortion in the flight direction, but the contours (especially higher levels) are approximately circular. Sound levels for the medium and medium-plus vehicles are about 3 to 5 dB lower than for the heavy vehicle. Heavy vehicles represent approximately 2 percent of the projected Concept B Cape Canaveral AS launches. Conservative impact estimates can be made by examining levels from the louder heavy vehicles.

Referring to Figure 4.12-12, maximum A-weighted levels in the nearest residential communities would be in the 80-dB range. This is comparable to the noise of a passing heavy truck (80 to 85 dBA). Occasional sounds of this level will not cause adverse impact. SEL has been computed for this launch, and is about 18 dB higher than the AWSPL. This corresponds to an effective duration of about one minute. Launch noise is likely to be audible for a longer period, but the total time involved is not great enough to cause substantial impacts.

Figure 4.12-15 shows the OSPL contours for the DIV-H. OSPL in excess of 110 dB, which could cause structural damage claims at a rate of one per 1,000 households, is limited to a radius of approximately 4 miles from the launch site. This area does not contain residential communities, and most of the land area affected is within Cape Canaveral AS and KSC. The OSPL at the nearest residential communities, 8 to 10 miles away, would be in the 100- to 105-dB range, where structural damage claims would occur at a rate of about one per 10,000 households. Damage potential for the smaller vehicles, which would be used for 98 percent of Cape Canaveral AS launches, would be substantially less.

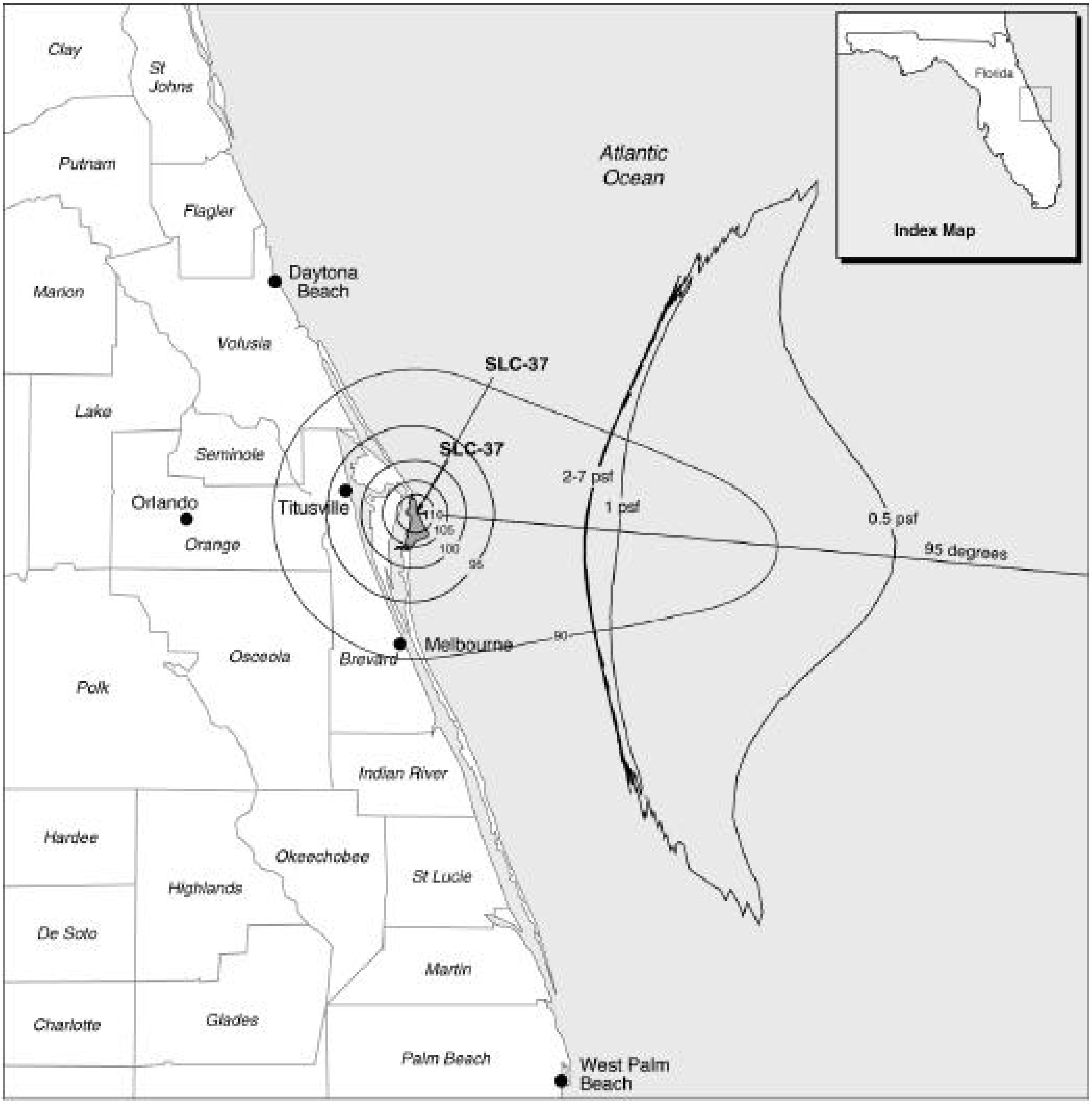
Sonic Boom. Figures 4.12-16, 4.12-17, and 4.12-18 show the sonic boom footprints for the heavy, medium-plus, and medium vehicles, respectively. The footprints have the characteristics described earlier. The maximum focus boom amplitude is 7.2 psf for the heavy vehicle. The carpet boom amplitude diminishes rapidly as the vehicle gains altitude. Sonic boom footprints for the other two missions (medium-plus and medium vehicles) are similar to that for the heavy vehicle mission, with comparable maximum overpressures and comparable or somewhat smaller areas.

Most of the boom footprints are below 1 psf at which level no adverse effects would be expected, even over land, from an occasional sonic boom. The maximum overpressures, in the narrow focal zones, are in the 6- to 8-psf range. Since the entire boom footprint is over water, the only potential impact is to wildlife (see Section 4.14, Biological Resources).

Figure 4.12-12 Maximum A-Weighted Sound Pressure Level, DIV-H, Cape Canaveral AS

Figure 4.12-13 Maximum A-Weighted Sound Pressure Level, DIV-M+, Cape Canaveral AS

Figure 4.12-14 Maximum A-Weighted Sound Pressure Level, DIV-H, Cape Canaveral AS



EXPLANATION:

Cape Canaveral AS

—90— Noise Contours (5 dB intervals)

psi Pounds per square foot

0 8 16 32 Miles

Sonic Boom Footprint, DIV-H Cape Canaveral AS

Figure 4.12-16

EFI V078

Figure 4.12-16 Sonic Boom Footprint, DIV-H, Cape Canaveral AS

Figure 4.12-17 Sonic-Boom Footprint, DIV-MT, Cape Canaveral AS

Figure 4.12-18 Sonic Boom Footprint, DIV-S, Cape Canaveral AS

Cumulative program noise impacts would be quantified by L_{dn} which has been computed for the busiest years. Values are about 50 dB lower than the AWSPL values seen in Figures 4.12-12 through 4.12-14. As discussed in Section 4.12.1.1.1, this is well within acceptable criteria for any type of land use.

4.12.1.2.2 Concept B, Vandenberg AFB

In-Flight Rocket Noise. Figures 4.12-19 and 4.12-20 show the in-flight maximum AWSPL for the DIV-H and DIV-M. These contours are very similar to the corresponding contours at Cape Canaveral AS, differing primarily in location and alignment with the launch trajectory. Contours for the DIV-M are approximately 5 dB lower than those for the heavy vehicle.

Considering the DIV-H (which would comprise 27 percent of Vandenberg AFB launches), maximum A-weighted levels in the nearest residential communities would be in the 80- to 85-dB range (see Figure 4.12-19). This is comparable to the noise of a passing heavy truck (80 to 85 dBA). Occasional sounds at this level would not cause adverse impact. SEL has been computed for this launch, and is about 18 dB higher than the AWSPL. This corresponds to an effective duration of the sound of about a minute. Launch noise is likely to be audible for a longer period, but the total time involved is not great enough to cause substantial impacts.

Figure 4.12-21 shows OSPL for the DIV-H. OSPL in excess of 110 dB, which could cause structural damage claims at a rate of one per 1,000 households, is limited to a radius of approximately 4 miles from the launch site. This area does not contain residential communities, and almost all of the land area affected is within Vandenberg AFB. The OSPL at the nearest residential community, Lompoc, about 8 miles away, would be in the 100- to 105-dB range, where structural damage claims would occur at a rate of about one per 10,000 households. Damage potential for the smaller vehicles, which would be used for 73 percent of launches, would be substantially less.

Sonic Boom. Figures 4.12-22 and 4.12-23 show the sonic boom footprints for the DIV-H and DIV-M, respectively. The boom footprints are offshore, in the Pacific Ocean. These footprints are similar to each other, differing primarily in position and orientation along the launch azimuth. The maximum overpressures, in the narrow focal zones, are in the 6- to 8-psf range. Impacts are expected to be minimal

The two boom footprints shown intersect the Channel Islands, with this intersection being at or near the focal zone. Potential impacts to wildlife are discussed in Section 4.14, Biological Resources.

Figure 4.12-19 Maximum A-Weighted Sound Pressure Level, DIV-H, Vandenberg AFB

Figure 4.12-20 Maximum A-Weighted Sound Pressure Level, DIV-M, Vandenberg AFB

Figure 4.12-21 Maximum Overall Sound Pressure Level, DIV-H, Vandenberg AFB

Figure 4.12-22 Sonic Boom Footprint, DIV-H, Vandenberg AFB

Figure 4.12-23 Sonic Boom Footprint, DIV-M, Vandenberg AFB

The two missions shown are at launch azimuths of 184 and 170 degrees. Concept B missions would have launch azimuths from 163 to 192 degrees. The booms would remain over the ocean, and differ in their relation to the Channel Islands.

Cumulative program noise impacts would be quantified by L_{dn} which has been computed for the years with the most launches. Values are about 45 dB lower than the AWSPL values seen in Figures 4.12-22 and 4.12-23. This is well within acceptable criteria for any type of land use. However, L_{dn} is not meaningful for events as infrequent as EELV launches, so the primary impact assessment is the single-event analysis presented above.

4.12.1.3 Concept A/B

Under Concept A/B, both Concept A and Concept B launch vehicle systems would be developed, and launches would be conducted as shown in Table 2.1-11. Noise and sonic boom from a given mission would be the same as for that mission for the corresponding Concept A or Concept B vehicle. Impacts would, therefore, be similar to the combined effects discussed in Sections 4.12.1.1 and 4.12.1.2. The total launch rate would be approximately the same, so cumulative noise impacts would also be the same as described in Sections 4.12.1.1 and 4.12.1.2.

4.12.2 No-Action Alternative

If the No-Action Alternative were selected, noise and sonic boom exposure would remain as it is under current operations (see Section 3.12). These levels are comparable to those that would result under the Proposed Action.

4.13 ORBITAL DEBRIS

4.13.1 Proposed Action

This section analyzes the potential impacts of the launch vehicle only. The environmental consequences of payloads that would utilize the EELV system to reach orbit would be addressed under separate NEPA documentation that would be prepared for each of the satellite programs, as required.

4.13.1.1 Concept A. Concept A would contribute to the overall space debris problem from the addition, although of limited duration, of intact upper stages to the orbital debris population through fragmentation if other debris were to collide with the intact upper stages. Because liquid propellants would be used, the typical solid rocket motor aluminum oxide dust emission impacts to the space environment would not occur.

The CUS used for HLV-G missions would remain in orbit after shutdown and separation from the payload. The CUS would be safed to vent residual propellants. Liquid hydrogen and oxygen would be vented through the engine valves without lighting the engine. Hydrazine would be vented through the settling thrusters. If propellants were not vented in a controlled manner, they would boil off, which would eventually cause relief valves to open. The resulting uncontrolled venting could cause the CUS to tumble.

Tumbling motion could cause components to break off and become space debris.

The intact upper stages would remain in orbit. However, at the altitudes at which the upper stages of the MLV-D, HLV-L, and MLV-A missions would separate from their payloads, residence time in orbit would be short, and the debris population at altitudes below about 435 miles is not likely to exceed the critical density necessary for collisional growth in debris. At these altitudes, atmospheric drag will typically remove collision fragments before they collide with another object (National Research Council, 1995). However, the upper stage of the HLV-G missions would remain in orbit after shutdown and separation from the payload for an indeterminate time, due to their much higher altitude of release, leaving a total of 8 upper stages in orbit between 2001 and 2020 (see Table 2.1-3).

EELV launch vehicles would be designed to be litter-free: i.e., separation devices, shrouds, and other expendable hardware would separate at a low enough altitude and velocity to keep them from becoming orbital. In addition, stage-to-stage separation devices and other potential debris would be kept captive to the stage with lanyards or other provisions to minimize debris (Office of Science and Technology Policy, 1995). Where possible, the use of new materials on the EELV launch vehicles would reduce the natural degradation and fragmentation that occurs in the harsh environment of outer space (Office of Technology Assessment, 1990).

Two of the principal mitigation measures that would be employed to minimize creation of orbital debris are the expulsion of all propellants and pressurants, and the addition of electrical protection circuits to batteries to preclude electrical shorts and add protection from explosion (Office of Science and Technology Policy, 1995).

The impacts of this principal source of orbital debris from Concept A would be a small, incremental contribution to the existing orbital debris population impacts already occurring under the existing launch programs and discussed in more detail in Section 3.13.

Mitigation Measures. The use of operational practices to limit the orbital lifetime of spent upper stages has the potential to mitigate the growth of orbital debris. Wherever possible, mission designers would select orbital parameters that would minimize the creation of additional orbital debris. Other preventive measures could include designing and building the EELV launch vehicle upper stages so that they would resist environmental degradation from atomic oxygen and solar radiation (Office of Technology Assessment, 1990). Using paint less vulnerable to atomic oxygen, for example, would be one possibility (Johnson & McKnight, 1988).

4.13.1.2 Concept B

Under Concept B, the hypergolic upper stage, Delta cryogenic upper stage, and heavy Delta cryogenic upper stage would re-enter the atmosphere, remain intact and burn up as they re-enter the atmosphere. However, the optional third-stage rocket motor for the DIV-S would go into elliptical orbit. The Star 48B would have an explosive composition and weight of 4,431 pounds and would remain in an elliptical orbit of about 100 miles perigee by 19,323 nautical miles for some unknown period of time (McDonnell Douglas, 1997b).

The contribution to the overall space debris problem from Concept B launches would be similar to that described for Concept A. In addition, solid rocket motor emissions from the DIV-M+ and from the Star 48B for the DIV-S would eject aluminum oxide dust into the orbital environment. Larger chunks of unburned SRM propellant or slag may also be released (ignited propellant will not burn completely outside the pressurized confines of the rocket body). However, as described in Section 3.13.3, solid rocket motor particles decay rapidly, and impacts are anticipated to be temporary and minor.

Although the intact upper stages would remain in orbit, at the altitudes at which the upper stages of the DIV-S, DIV-M, and DIV-H missions would separate from their payloads, residence time in orbit would be short, and the debris population at altitudes below about 435 miles is not likely to exceed the critical density necessary for collisional growth in debris. However, the Star 48B would remain in orbit after shutdown and separation from the payload for an indeterminate time, due to its much higher altitude of release (see Table 2.1-8).

The impacts of these two principal sources of orbital debris from Concept B would be a small, incremental contribution to the existing orbital debris population impacts already occurring under existing launch programs. As described for Concept A, EELV launch vehicles would be designed to minimize creation of orbital debris.

Mitigation Measures. Mitigation measures would be similar to those discussed in Section 4.13.1.1.

4.13.1.3 Concept A/B

With an estimated 532 launches under Concepts A and B, and 534 under Concept A/B between 2001 and 2020, for an average of just under 27 per year, and a projected peak annual launch rate of 30 missions in both 2006 and 2014, the contribution of Concept A/B to the orbital debris environment would be similar to that described for Concepts A and B.

4.13.2 No-Action Alternative

The No-Action Alternative, like any other launch vehicle program, including EELV, would contribute to the orbital debris population, as described for Concept A. It would also contribute to the problem of pollution in outer space that includes determination of paint and insulation, as well as radio-frequency interference and interference with scientific observations in all parts of the spectrum, as noted in Section 3.13. The continued use of older launch vehicles would not present the same opportunities for implementation of the mitigation measures identified below that use of the newer EELVs would allow.

4.14 BIOLOGICAL RESOURCES

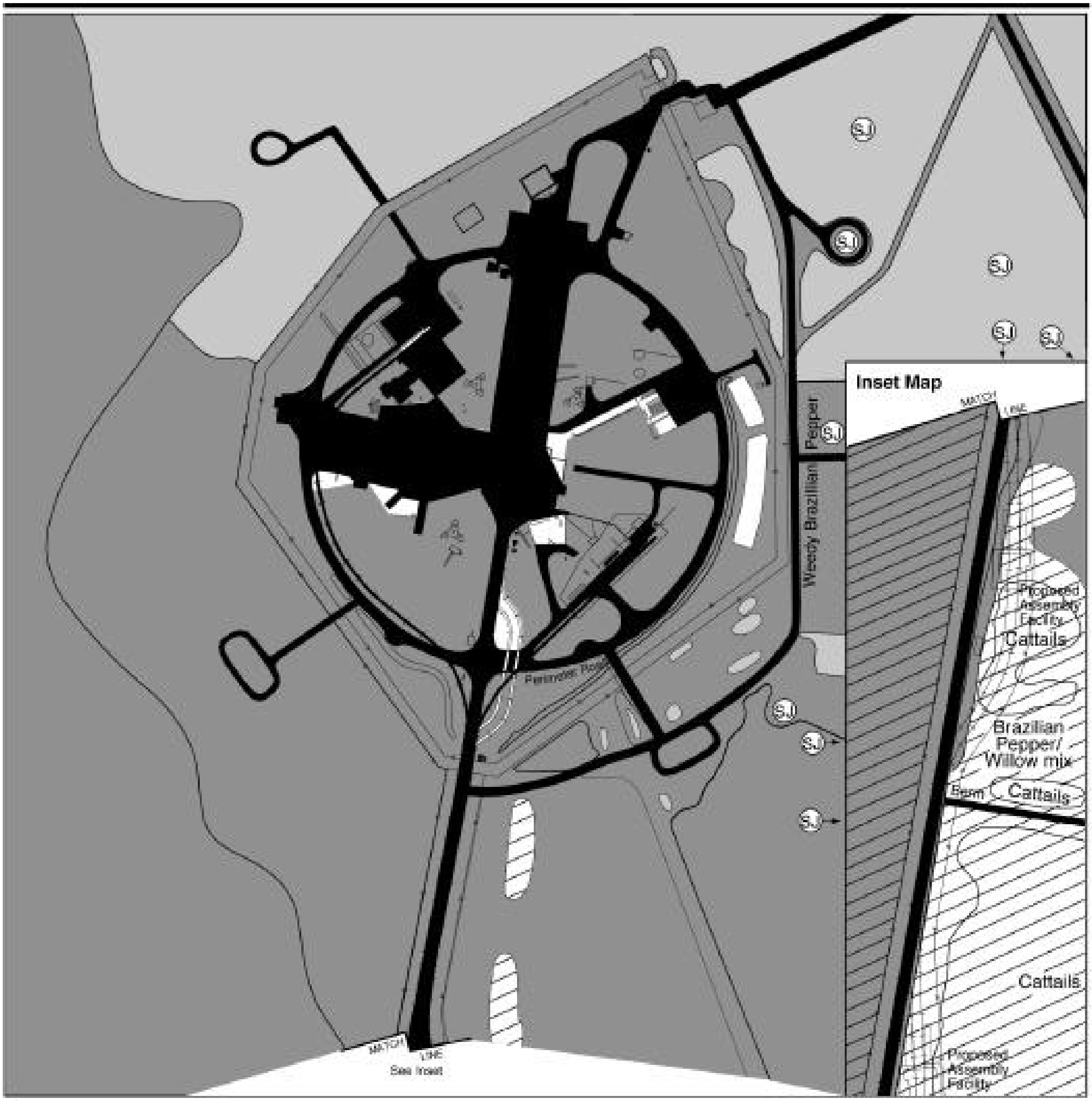
4.14.1 Proposed Action

EELV launch activities with the potential to affect biological resources include loud noises associated with launches including sonic booms, extreme heat/fire in the vicinity of the launch pad, visual impact from the rocket flight path, and vapor from the deluge system associated with launches; the dropping of the booster, payload fairings, and HLV side boosters containing kerosene fuel into the ocean; and use of security lighting at the SLCs.

4.14.1.1 Concept A

4.14.1.1.1 Concept A, Cape Canaveral AS. At Cape Canaveral AS, other potential impacts to biological resources from Concept A could occur from ground-disturbing activities at SLC-41, at the assembly facilities construction site, at road intersections that would be modified, and from launch activities at SLC-41 that would affect the biological resources in the extended vicinity. All other facilities would be used as is, or the modifications would be either internal to the building or on a concrete apron outside of the building. Biological resources impacts would not be expected from use of these facilities. Figure 4.14-1 shows the locations of vegetation and sensitive habitat associated with proposed construction at SLC-41.

Vegetation. The impact to vegetation from this concept would be minimal. The vegetation at SLC-41 is a mixture of mowed grasses and forbs. The area is currently affected by deposition of HCl and aluminum oxide associated with SRM launches which has resulted in changes to the vegetation community composition by elimination of species sensitive to this effect. Concept A would use only liquid fuels that would not result in acid deposition. The effect to the surrounding vegetation would be beneficial, allowing sensitive species to reestablish if conditions are otherwise



EXPLANATION

- Security Fence
- Scrub Jay territories
- Developed
- Drainage ditch (open water)
- Barren
- Brazillian Pepper
- Maritime Hammock
- Mowed or open grassland
- Oak or Coastal Scrub (FL Scrub Jay habitat)
- Saltwater marsh
- Wetland
- New Proposed Facilities

0 150 300 Feet

Source: Aerial photograph, Smith Environmental Services, 1997; Earth Tech, 1997; site visit, 1997.

SLC-41 Vegetation and Sensitive Habitat Cape Canaveral AS, Florida

Figure 4.14-1

EEL/109

appropriate. Removal of 13 acres of road shoulder (mowed grass and Brazilian pepper or fill), wetland scrub (Brazilian pepper/willow mix), and wetland marsh vegetation (mostly cattail marsh) for the construction of the assembly facilities would cause minimal impact to the native vegetation in the area because the area has been previously disturbed and little native vegetation remains. Of the area to be disturbed, only 1.5 acres is in high-quality maritime hammock community that has not been extensively altered by non-native species. However, this is in four small areas and does not account for any notable contiguous habitat on Cape Canaveral AS. Wetland impacts will be discussed under Sensitive Habitats.

Launch effects on vegetation include burning of areas adjacent to the flame trenches and defoliation due to heat. Near-field deposition of debris from launch could also damage vegetation. Areas affected by the deluge vapor cloud could suffer damage from the hot water, but this should not result in any changes that would affect the composition of the vegetation community.

An anomaly on the launch pad could produce extreme heat and fire that could burn adjacent vegetation.

Wildlife. Wildlife would be temporarily displaced during the construction of the assembly facilities and other ground-disturbing activities, but the effect to the wildlife population would be negligible because the foraging and nesting habitat that would be impacted is of poor quality, and because adjacent similar habitat is nearby. The most important wildlife impact would occur during the launch activities.

The visual disturbance from pre-launch patrol aircraft overflight often creates more disturbance than the launch itself. The greatest effect of aircraft overflight on animals is from the visual effect of flying aircraft and the sound of its approach. Pre-launch patrol aircraft could temporarily disrupt nesting or feeding birds along the Banana River if flown below 550-feet above ground level (AGL). The 550-foot AGL zone has been shown to account for most wildlife reaction to visual stimuli (Bowles et al., 1991; Lamp, 1987). A report to Congress in 1992 by the U.S. Forest Service reviewed existing literature assessing wildlife impacts from aircraft overflight effects. The report concluded that, although aircraft overflights are initially startling, animals generally adapt by habituating behaviorally and physiologically to the challenge. The report concluded that overflights generally pose negligible risks to wildlife. Therefore, effects of patrol aircraft activities on wildlife are expected to be negligible.

Direct launch effects on the wildlife in the near-field area include incidental death from heat, loss of hearing to various degrees, and temporary disruption of life patterns such as feeding, roosting, and moving about. Because this launch pad is currently being used for rocket launches, resident species sensitive to these disturbances are not likely to be found in the nearby vicinity. Individuals that wander into the area during a launch could be lost, but the effects to the populations nearby from this loss would be negligible.

Wild animals exposed to sudden intense noise can panic and injure themselves or their young; however, this is usually the result of the noise in association with the appearance of something perceived by the animals as a pursuit threat, such as a low-flying aircraft. EELV launch noise is not expected to cause more than a temporary startle-response because the "pursuit" would not be present. Any loss or injury as a result of this startle response would be incidental and not a population-wide effect. Noise associated with EELV launches may startle many species within the area including the Indian River habitat, but actual losses are expected to be minimal.

Sonic booms created by the launch would occur over the open Atlantic Ocean. The effects of a sonic boom on whales or other open ocean species are not known. Because these sonic booms are infrequent, the marine species in the ocean's surface waters are present in low densities (although spring and fall migration will see periodic groups of migrating whales that follow the coastline), and the sonic boom footprint lies over 30 miles from Cape Canaveral AS, the sonic booms from EELV launches are not expected to negatively affect the survival of any marine species.

A residual amount of hydraulic fluid would remain in the stages when they fall into the ocean. If released, the fluid would be diluted by the vast amounts of sea water and is not expected to affect marine species. The chances that the stages would strike a marine mammal are unlikely due to the extent of the open ocean and the general scarcity of marine mammals in open ocean areas.

An anomaly on the launch pad would also present potential impacts to biological resources due to the possibility of extreme heat and fire, and from percussive effects of the explosion. The explosion could injure or kill wildlife found adjacent to the launch pad or within debris impact areas. Potential fires started from the anomaly could result in a temporary loss of habitat and mortality of less mobile species. On SLC-41, fire would probably be limited to areas adjacent to the launch pad because of the amount of surrounding water. A mishap downrange would occur over the open ocean and would not likely jeopardize any wildlife, given the relatively low density of species within the surface waters of these open ocean areas.

Threatened and Endangered Species. Concept A may potentially affect species protected under the federal Endangered Species Act, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act. Concept A would require compliance with the federal Endangered Species Act of 1973 (16 U.S.C. Sections 1531-1547, et al.) if a federal agency determines that there may be a potential impact to individuals, populations, or habitat of a species listed under the Endangered Species Act. Section 7 of this act requires the proponent federal agency to conduct endangered species consultation prior to irreversible and irretrievable commitment of resources for all federal actions that pose endangered species concerns. Formal consultation is a process between the USFWS and the proponent federal agency that concludes with the USFWS's issuance of an opinion stating whether or not the action is likely to jeopardize the continued existence of a listed species. Although formal consultation has not been initiated with the USFWS, informal consultation will occur through the agency's review of this EIS and the Air Force's request for mitigation planning. The USFWS will evaluate the need for formal consultation for the EELV program.

Two species state-listed as threatened (the golden polypody found in the 1.5 acres of maritime hammock, and the giant leather fern found in the Brazilian pepper/willow community) are expected to be directly affected by the construction activities associated with Concept A in the assembly facilities construction areas. These species are locally abundant and are not listed as rare on Cape Canaveral AS by the Florida Natural Areas Inventory (FNAI) (Smith Environmental Services, 1997). Therefore, the removal of a few individuals by the assembly facility construction would not threaten the range recovery or survival of these species. The area to be disturbed does not contain suitable scrub jay habitat. The American alligator is present at the assembly facility site but is abundant at Cape Canaveral AS and will move away from construction activities. No negative effect is expected to this species from construction activities. Most of the impacts to threatened and endangered species would occur from launch activities.

Four Titan IVB launches were monitored in 1990 from SLC-40 and 41 for effect on the scrub jay. No mortality was observed. All banded individuals were located four hours after the launches, and none showed signs of distress. Each responded to taped scrub jay calls played by investigators. Fire caused by one of the launches did disrupt the scrub jays in the area, who exhibited unusual intensity and duration of scolding behavior. The burned area was avoided by the birds for approximately one month (Larson et al., 1993). The Titan IVB launch vehicle is larger than the EELV; therefore, effects from EELV launches are anticipated to be less than from Titan launches.

Effects to sensitive birds in the nearby estuaries (wood stork and bald eagle) or shorelines (least tern and piping plover) would be similar to those described for wildlife. The launches are not expected to jeopardize the continued existence of any listed species due to the intermittent nature of the disturbance and the ability of wildlife to habituate to disturbance or to return to normal behavior after a startle response.

Manatees are relatively unresponsive to human-generated noise to the point that they are often suspected of being deaf to oncoming boats (although their hearing is actually similar to that of pinnipeds) (Bullock et al., 1980). Since manatees spend most of their time below the surface, and since they do not startle readily, no effect of aircraft or launch vehicle overflights on manatees would be expected (Bowles et al., 1991).

Sea turtle adults and hatchlings are sensitive to artificial incandescent, metal halide, or high-pressure sodium lighting near their nesting beaches. The hatchlings use moonlight on the ocean water for directional guidance after emerging from the nest. If lighting inland is brighter than the moonlight, sea turtles may become confused and head the wrong way, never reaching the water. A new light management plan will need to be developed for SLC-41 that addresses the new lighting configuration to prevent negative sea turtle impacts. Any changes in this lighting would necessitate development of a new light plan and would require consultation with the USFWS under Section 7 of the Endangered Species Act. Cape Canaveral AS has lighting guidelines requiring low-pressure sodium lighting to minimize impacts to the sea turtle population.

Impacts of an anomaly would be as described for Wildlife, and could affect scrub jay habitat.

Sensitive Habitats. Wetlands would be impacted from clearing vegetation and constructing assembly facilities in a 15-acre project site. Up to 8.2 acres of these are jurisdictional wetlands that could be impacted. The wetlands are Brazilian pepper/willow (5.2 acres) and cattail (3 acres) wetland communities that have low species richness and are not quality wetland habitats. The loss of these degraded wetland types would be mitigated as required in the appropriate permits.

Activities affecting federal jurisdictional wetlands would be subject to EO 11990 for the Protection of Wetlands and Section 404 of the CWA. Under the CWA, any action that would directly involve the placement of fill material in wetlands or other Waters of the United States is subject to the permit requirements of Section 404. According to U.S. EPA regulations issued under Section 404(b)(1), the permitting of fill activities will not be approved unless the following conditions are met: no practicable, less environmentally damaging alternative to the action exists; the activity does not cause or contribute to violations of state water quality standards or jeopardize endangered or threatened species; the activity does not contribute to significant degradation of waters of the United States; and all practicable and appropriate steps have been taken to minimize potential adverse impacts to the aquatic ecosystem (Title 40 CFR 230.10). Further, the guidelines establish a presumption, which the applicant has the opportunity to rebut, that for non-water-dependent projects, a practical alternative to the filling of wetlands exists.

The SJRWMD Environmental Resource Permit: Surface Water Management Systems (Chapter 40C-4, F.A.C.) is a joint application with the Section 404 Dredge and Fill Permit. Florida’s wetland program regulates dredge and fill activities in both fresh and salt waters under their jurisdiction. Jurisdictional waters include surface waters that are present all year and that are greater than 10 acres at a minimum average depth of 2 feet existing throughout the year, and permanent flowing streams and tributaries. Waters adjoining Florida’s coastline are also under the state’s jurisdiction.

The Banana River, which is adjacent to SLC-41, is manatee critical habitat. However, monitoring of manatee habitat conducted for the space shuttle program has revealed no lasting effect in these waters after a launch has taken place. Therefore, Concept A launches are not expected to adversely affect manatee habitat. The use of liquid propellants would not result in the production of an acid cloud such as that currently produced by Titan IVB launches, resulting in overall beneficial effects to manatee habitat.

Effects to rookeries in the waters surrounding the SLC from launch overflight would be as discussed for Wildlife.

Effects of noise and sonic booms from EELV launches on sensitive habitats would be as described for Wildlife.

An anomaly on the launch pad would frighten nearby sensitive species utilizing the Indian and Banana Rivers, such as birds in rookeries and neotropical migrants. Manatees, sea turtles and other aquatic species are not expected to be adversely affected by an anomaly.

Mitigation Measures. To mitigate the threat to sea turtle nestling survival caused by artificial light sources, only low-pressure sodium lighting fixtures would be used for exterior lighting applications. A new light management plan will be required for SLC-41 construction. Any exceptions to using low-pressure sodium lighting would be coordinated with 45 CES/CEVP and would require Section 7 consultation with USFWS.

Project planning and facility design have been conducted to minimize potential impacts to wetlands through avoidance of direct or indirect disturbance to quality salt marsh wetland communities. Other mitigation measures could include replacement of any wetlands lost at a ratio determined through consultation with the USFWS, the USACE, and the SJRWMD; protection or restoration wetland habitat away from the site for replacement; and monitoring (until habitat becomes well established) of any replacement wetlands in order to determine the effectiveness of replacement and to identify any necessary remedial measures. Avoidance of disturbance could include controlling runoff from demolition and construction sites into drainages through use of berms, silt curtains, straw bales, and other appropriate techniques. Equipment could be washed in areas where wash water could be contained and treated or evaporated. A FONPA will be prepared by the Air Force, as required by EO 11990, and must be signed by SAF/MIQ before activities that could affect wetlands are initiated.
Proposed mitigation measures for wetlands at SLC-41 (Smith Environmental Services, 1997) include providing a 6 to 1 enhancement of existing wetlands through reconnection of the 58-acre “West Marsh Area” to the Banana River by removing the berm, which has already failed in one place. A biological monitoring program could be included in the final mitigation proposal to determine if impoundment restoration goals are being achieved. The removal of the berm would allow the waters to ebb and flow with the tide and allow an exchange of nutrients and marine species. Cattail density would be expected to decrease with the decrease in water level stability, creating a diverse habitat capable of supporting a greater number of species.

4.14.1.1.2 Concept A, Vandenberg AFB. At Vandenberg AFB, potential impacts to biological resources from Concept A could occur from ground-disturbing activities at SLC-3W, at the assembly facilities, power substation, USF construction sites, at road intersections that would be modified, and from the 14 launch activities per year at SLC-3W. All other facilities would be used as is, or the modifications would be internal to the building. Biological resources impacts would not be expected from use of these facilities. Figure 4.14-2 shows the locations of vegetation and sensitive habitat associated with proposed construction at SLC-3W.

Vegetation.

Vegetation disturbance would be minimal for this concept. Areas that would be disturbed during facility construction are bladed road shoulders, mowed grasses and forbs, and weedy parking areas. The intersections that would be modified do not contain any sensitive plant communities. Launch effects on vegetation at SLC-3W would be similar to those described for SLC-41 at Cape Canaveral AS, under Vegetation in Section 4.14.1.1.1.

An anomaly on the launch pad could produce extreme heat and fire that would present potential impacts to vegetation. Vandenberg AFB has a high hazard risk for wildfire, which could result from an anomaly.

Wildlife. Wildlife would be temporarily displaced during the construction of the assembly buildings and other ground-disturbing activities, but the effect to the wildlife population would be negligible because sufficient suitable habitat is present nearby. The most important wildlife impact would occur during the launch activities. General sonic boom studies and specific studies for the species on Vandenberg AFB and the Channel Islands have been conducted.

Launch noise at levels as low as 80 dBA caused a short-term (30-minute) abandonment of a pinniped haul-out area at Vandenberg AFB (Tetra Tech, 1997b). EELV launches would create noise levels lower than 80 dBA at

Figure 4.14-2 SLC-3W Vegetation and Sensitive Habitat, Vandenberg AFB, California

Purisima Point, but would create launch noise of 85 dBA at Rocky Point. However, short-term haul-out area abandonment has not caused noticeable impacts on the pinniped populations at these locations. Therefore, EELV effects from launches from SLC-3W will be temporary and minor, and are not expected to negatively affect these populations. The two pinniped haul-out areas along Vandenberg AFB's coast (Purisima Point and Rocky Point) are shown on Figure 3.14-4.

The sonic boom footprint of the HLV could affect San Miguel and Santa Rosa Islands with up to 5 psf. However, most of the launches would be with MLVs that could cross Santa Rosa Island with overpressures of up to 6 psf. The trajectories vary, however, so the sonic boom may occur over San Miguel Island, or may miss the Channel Islands completely. Titan IVB vehicles launched from SLC-4E created focused sonic booms over the northern Channel Islands but showed a lack of significant impact to biota of San Miguel Island (Versar, 1991). The Titan IVB launch effects would be similar to those of the HLV launches from SLC-3W, and would be greater than those of the EELV launches. None of the studies summarized in the Final Programmatic EA for the Marine Mammal Take Permit showed injury or pup abandonment during all noise levels and sonic boom overpressures observed from any launch site, although temporary abandonment of haul-out places were of a longer duration for those areas subject to higher noise levels (Tetra Tech, Inc., 1997b).

Launch noise effects on cetaceans appear to be somewhat attenuated by the air/water interface. The cetacean fauna in the area have been subjected to sonic booms from military aircraft for many years without apparent adverse effects (Tetra Tech, Inc., 1997b).

Launches from Vandenberg AFB require a take permit from the NMFS in order to address the harassment of marine mammals under the Marine Mammal Protection Act. Vandenberg AFB has prepared a 5-year draft programmatic take permit (June 1997) consolidating different launch programs that would allow incidental harassment of marine mammals to occur during their associated launches (Appendix H). The take permit final rule should be published by December 1997 (Lagamorsino, 1997). Depending on the approval timing of the permit with the timing and needs of the EELV program, this programmatic permit may meet the take permit requirements of EELV launches.

An anomaly on the launch pad could present potential impacts to wildlife from fire and from the percussive effect of the explosion and falling debris. The Santa Ynez River and Florida and Bear Creeks present optimal riparian habitat for numerous species that could be killed by a fire. Habitat fires could drive mountain lions known to occur near SLC-3 to less optimal habitat, although they would return with habitat regrowth. Debris from a downrange anomaly could impact in the open ocean, the channel, or on the Channel Islands. Given the large amount of area beneath the flight path, it is unlikely that debris would fall in an area heavily populated by wildlife.

Threatened and Endangered Species. Impacts to threatened, endangered, or sensitive species from a launch are not expected to jeopardize the existence of any species. Impacts from EELV launches would be similar to or less than those of Titan IVB launches from SLC-4.

Helicopter security overflights for EELV launches would be similar to those in support of Titan IVB launches. Disturbance of snowy plovers during any security overflights will be addressed during consultation with the USFWS. Although the overall effects are expected to be minor, monitoring of these responses may be necessary for impact mitigation. The Titan IV helicopter activity flushed sanderlings (not a threatened or endangered species), whose agitated behavior in turn flushed snowy plovers.

Between 1973 and 1993, Atlas E/F launches were conducted at SLC-3W. Data from 1991 to 1993 indicate that up to seven pairs of flycatchers nested in this area in spite of these launches (Holmgren, 1995). Therefore, EELV launches are expected to have only a minimal impact on nesting willow flycatchers along the Santa Ynez River. As with other birds, potential impacts to this species are expected from direct, low-altitude overflight of aircraft during pre-launch security patrols.

Least terns at the Purisima site show a lack of observable impact from Titan IVB launches from SLC-4 (Read, 1996a). Snowy plovers flushed at launch but returned to normal behavior soon after (Read, 1996a,b). EELV launches from SLC-3W would have less impact upon these birds because the launch site is farther from the coastline and most of the EELV launch vehicles are smaller than the Titan IVB. The least tern nesting colony near SLC-2 experienced significant impacts from Delta II launches from SLC-2 in 1997 (Read, 1997). EELV would eliminate launches from SLC-2W and would, therefore, reduce the impacts to this nesting area.

Peregrine falcons nest within areas that could be subjected to high noise levels from launch activities. This exposure could cause lower nesting success of peregrines if launches were to occur during the nesting season, as supported by studies outlined in Appendix F.

Launch noises could disrupt the feeding and roosting activities of brown pelicans off the coast of Vandenberg AFB by causing a startle effect.

Potential impacts from launch noises to the unarmored threespine stickleback and the tidewater goby are expected to be minimal because noise is readily and well attenuated by water. Launch noises may potentially startle the red-legged frog, but the effect is expected to be temporary. Replacement of existing launch vehicles that use solid rocket motors with the EELV would result in a beneficial impact to these aquatic species because EELV launches would not result in acid deposition in aquatic habitats, as launches using solid rocket motors do.

The southern sea otter is found off the coast of Vandenberg AFB in a small breeding colony off Purisma Point near SLC-2. Larger populations are found primarily to the north of the base with an increase in sightings of sea otters along Vandenberg AFB's north shore. Concept A would eliminate launches from SLC-2W, which is situated on North Vandenberg AFB. Launches from South Vandenberg AFB are less likely to adversely affect the sea otter, and could result in overall beneficial effects to the species.

Impacts of an anomaly would be as described for Wildlife. In addition, the endangered beach layia (plant) is 1.3 miles west and could be affected by a fire.

Sensitive Habitats. A willow wetland has been identified on SLC-3W. Construction plans of a road may affect the edge of the wetland (approximately 0.03 acre) closest to the fence. If this wetland is affected, consultation under Section 404 and a FONPA, as required by EO 11990 would be conducted, as described for Cape Canaveral AS. The Channel Islands are also a sensitive habitat and have been addressed under Wildlife. Vandenberg AFB is a significant shorebird migration/wintering area, and these birds are disturbed by launches from South Vandenberg AFB to as far north as SLC-2W. However, launches occur from SLC-2W, and the shore birds continue to use the area.

SLC-3W is close to known major overwintering monarch butterfly sites in Spring Canyon. It is 1.25 miles south of and downwind of the launch site, just south of SLC-4. Hazardous byproducts from launch are not expected from the liquid fuels used for this concept. A benefit to the butterflies would occur from eliminating launches using solid rocket motors that emit HCl at SLC-4. Therefore, no impacts to butterflies are anticipated.

White-tailed kite foraging habitat is over the grasslands and coastal sage scrub in the area. Although launches could be disruptive to foraging activities, the launches are expected to cause only a temporary startle effect and would not negatively affect the kite population.

Impacts to seabird nesting and roosting areas are discussed under the preceding Threatened and Endangered Species section.

Impacts from an anomaly would be as described under Vegetation and Wildlife. Burton Mesa Chaparral, a state-sensitive plant community 2 miles inland, supports sensitive bird species, including Bell's sage sparrow and Southern California rufous crowned sparrow. These species could be adversely affected by a wildfire at Vandenberg AFB. Burning of the butterfly trees would make them unsuitable for the overwintering monarchs. Burning of nesting habitat along Bear Creek may lower the reproductive success of the species that use this habitat.

Mitigation Measures. Studies conducted before, during, and after Titan IVB launches from SLC-4 in May and December 1996 have resulted in several recommended mitigations for future monitoring of sensitive species. Cumulative effects of multiple launches could cause a particularly sensitive species to abandon the area or have low breeding success. Monitoring could help identify these effects, if they occur.

All space launch effects on marine mammals would be monitored according to the monitoring measures that have been proposed by the take permit application, if adopted.

A Biological Opinion for Titan IVB launches from SLC-4 requires monitoring of sample populations of western snowy plovers, California least terns, peregrine falcons, and southwestern willow flycatchers before, during, and after launches during the breeding season and monitoring of sample populations of wintering western snowy plovers during the non-breeding season. No impacts to their continued use of habitat areas or nesting success of wintering and nesting snowy plovers has been observed, although they may flush at the sight and sound of a launch. However, impacts to snowy plover from SLC-3 launches have not been studied, and SLC-3 launches would result in more direct overflight of snowy plover habitat than launches from SLC-4. Therefore, monitoring of snowy plovers is warranted (Read, 1997). Pre-launch helicopter security patrols cause the most disruption to snowy plover behavior, so every effort must be made to ensure that these patrols do not unduly disturb this species (Read, 1996a). This would be accomplished through coordination with Environmental Management at Vandenberg AFB in order to apprise the security overflight personnel of the areas sensitive to direct overflight.

Least terns at the Purisima site also show a lack of observable impact from Titan IVB SLC-4 launches. However, monitoring of these least terns would be required because there are no data from launch effects on least terns from SLC-3 launches. If least terns re-establish a nesting site near the Santa Ynez River, terns at this location should be monitored for launch-related effects.

Pre- and post-launch monitoring of peregrine falcons could be conducted during the incubation and fledgling periods to note any breakage of already thin eggshells. Environmental Management would identify nest sites and nesting phases of concern during each year as identified through their ongoing sensitive species status monitoring program.

Possible wetland mitigations would be required if the edge of the SLC-3 wetland is affected by construction.
Impacts of fire caused by an anomaly would be minimized through the fire response practices established through Vandenberg AFB Fire Regulation 92-1. Brush management in the areas around SLC-3 would keep the heat of the fire lower to help preserve root systems and facilitate recovery after a fire.

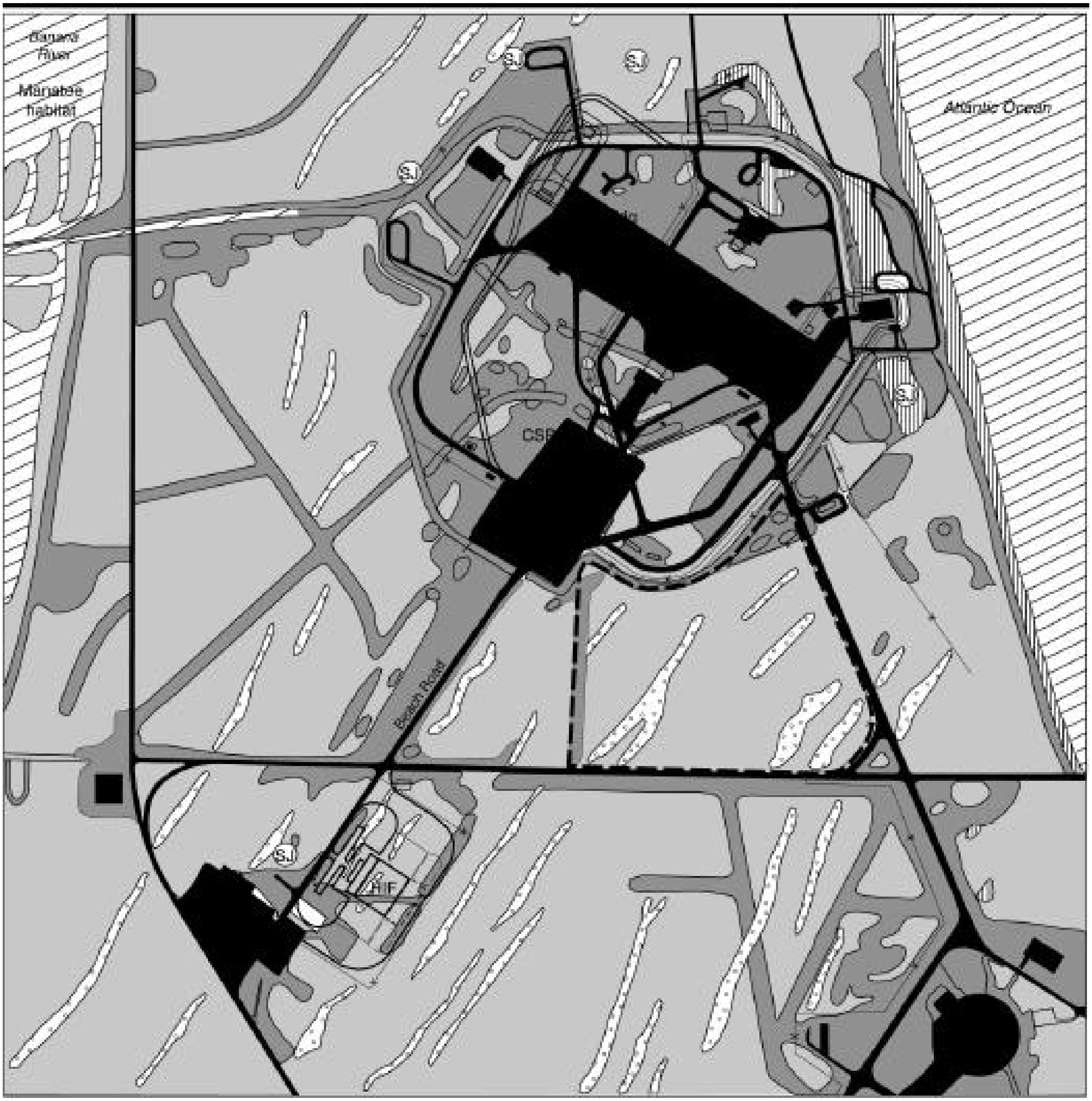
4.14.1.2 Concept B

Under Concept B, proposed activities that could potentially affect biological resources include ground disturbance during facility construction and modifications; loud noises, including sonic booms, extreme heat/fire in the vicinity of the launch pad, the overflight by prelaunch patrol aircraft and the rocket, and vapor from the deluge system associated with launches; the impact of the common core booster, payload fairings, and HLV side boosters into the ocean; use of security lighting; and maintenance of a clear zone at the SLCs.

4.14.1.2.1 Concept B, Cape Canaveral AS. At Cape Canaveral AS, potential impacts to biological resources from Concept B could occur from ground-disturbing activities during the construction of the two launch pads at SLC-37, at the HIF construction site, and along new utility corridors, from dredging activities at the roll on/roll off dock, and from launch activities at SLC-37. All other facilities would be used as is, or the modifications would be either internal to the building or on a concrete apron outside of the building, and would not entail ground disturbance. Therefore, biological resources impacts would not be expected from use of these facilities. Additional potential impacts to biological resources from commercial activities include adverse effects of acid deposition resulting from use of solid rocket motors (commercial launches only). Figure 4.14-3 shows the locations of vegetation and sensitive habitat associated with proposed construction at SLC-37.

Vegetation. The impacts to vegetation would include clearing 60 to 70 percent of the scrub within the SLC-37 perimeter fence. Scrub also may be cleared along the road leading to SLC-37 in order to install a nitrogen gas line. However, this vegetation comprises mostly Brazilian pepper. Removal of this weedy, aggressive species would be beneficial to the ecosystem. Installation of the wastewater and electrical line would require the clearing of undisturbed scrub to create the utility corridor. Although clearing of scrub can provide an opportunity for invasion of weedy species, if weedy species are controlled, clearing dense scrub areas is beneficial to the plant community because it allows new growth to occur. Vegetation impacts associated with clearing scrub for construction of the HIF or utility lines would be compensated for under the habitat compensation plan for scrub jay habitat impacts (see Threatened and Endangered Species in this section).

Effects on vegetation from launches associated with some commercial launches could include burning of areas adjacent to the flame trenches and



EXPLANATION

- HIF — Horizontal Integration Facility
- S.J — FL Scrub Jay territories
- Swale
- New proposed facilities
- Developed
- Open water
- Coastal dune vegetation
- Coastal strand vegetation
- Mowed or open grassland
- Oak or Coastal Scrub (FL Scrub Jay habitat)
- Open sand (Beach mouse habitat)
- Palmettos
- Wetlands/ wet areas
- Proposed mitigation area

0 200 400 800 Feet

Source: Aerial photograph interpretation following site visit, 1997; Earth Tech, 1997.

SLC-37 Vegetation and Sensitive Habitat Cape Canaveral AS, Florida

Figure 4.14-3

EEL/111

defoliation caused by heat. Near-field deposition of launch debris could also damage vegetation around the launch pad, including dune scrub and coastal scrub vegetation. The effects to the vegetation communities in the region from EELV launches are expected to be minor because only a very small portion of available habitat would be affected.

The solid rocket propellant associated with some commercial launches produces an acid cloud that can damage vegetation when it settles to the ground. The effects of the acid cloud produced by space shuttle launches from KSC are well documented and are summarized below. The effects of Concept B commercial launches would be less than those from space shuttle launches because the smaller solid rocket motors associated with EELV would produce smaller acid clouds.

Space shuttle launches cause local environmental impacts in the areas surrounding the launch pad. Exhaust from the solid rocket boosters combines with deluge water to create an acidic cloud (American Institute of Aeronautics and Astronautics, 1993). Primary components of this cloud include water, carbon dioxide, aluminum oxide, and hydrochloric acid (National Aeronautics and Space Administration, 1985). The hydrochloric acid and aluminum oxide are the components that affect the biota. A ground cloud that is approximately 1.4×10^6 m^3 in volume forms within the first 10-12 seconds of a launch. The cloud then cools, rises, and begins to move away from the launch site with prevailing winds.

Near-field deposition results in vegetation damage and temporary increases in available metals in water and soils. Effects of repeated near-field deposition include loss of sensitive species, decline in shrub cover, and resultant erosion. Hydrochloric acid and aluminum oxides from space shuttle launches were found to cause acute vegetation damage in an area of about 54 acres near the launch pad; however, effects from EELV launches would be less than described for the space shuttle. The changes include loss of sensitive species, loss of plant community structure, reduction in total cover, and invasion by weedy species (National Aeronautics and Space Administration, 1985). Acute damage to strand and dune vegetation, especially to sensitive species, was noted from the space shuttle at distances of up to 0.75 mile northeast of the launch pad, but the vegetation recovered within 6 months. Although there are increased levels of metals in the water (i.e., lagoon and Banana River system) and soils, cumulative decreases in pH have not occurred because local soils and surface water are well buffered.

Far-field deposition results from the launch cloud rising and moving with the prevailing winds. No cumulative effects of far-field deposition have been identified, although acid spotting on vegetation and other structures has been observed. Far-field acidic and dry aluminum oxide fallout from the launch cloud of the space shuttle was observed at locations of up to 14 miles from the launch pad and caused vegetation spotting over 1 to 5 percent of the leaf surface area, but no plant mortality or community damage resulting from far-field deposition has been identified (National Aeronautics and Space Administration, 1985). Effects of EELV launches would be lower than those of the space shuttle; therefore, no impacts are expected.

Impacts to vegetation from an anomaly would be damage from extreme heat and fire, as described for Concept A. Overgrown scrub would benefit from the clearing of the dense vegetation. Hydric hammock and mangroves would be negatively affected. Additionally, the cloud of airborne HCl released would be larger than under normal launch conditions because it would all be generated at ground level. Because the EELV would emit smaller amounts of HCl, the effects of EELV launches would be expected to be less than those described for space shuttle launches.

Wildlife. Wildlife would be temporarily displaced during construction and other ground-disturbing activities, but the effect to the wildlife population would be negligible because sufficient suitable habitat is available nearby. The most important wildlife impact would occur during the launch activities.

The visual disturbance, direct launch effects, intense noise, and general wildlife effects from sonic booms would be as described in Section 4.14.1.1.1.

NASA conducted a thorough evaluation of the effects of rocket systems that impact in seawater. This study considered sounding rockets, which have a solid propellant. It was concluded that the release of missile-related hazardous materials into seawater would not be significant. The study determined that materials would be rapidly diluted and, except in the immediate vicinity of the debris, would not be found at concentrations identified as producing any adverse effects (U.S. Army Space and Strategic Defense Command, 1994; National Aeronautics and Space Administration, 1994). Any area affected by the release of the propellant as the rubber matrix dissolves would be relatively small due to the size of the rocket motor or propellant pieces relative to the quantity of water. Sensitive marine mammals are widely scattered, and the probability that one would encounter or ingest the slowly decaying propellant or a toxic chemical/seawater solution is remote (U.S. Department of the Navy, 1996).

Solid propellant causes an acid cloud during launch. Fish kills have been noted from near-field space shuttle launch effects (Knott et al., 1983, Milligan and Hubbard, 1983, Hawkins et al., 1984). Although the effects from EELV launches are not expected to be as severe as for the space shuttle launches because of the smaller acid cloud that would be produced, temporary increases in acidity in the surface waters surrounding the launch site are expected, and fish kills could occur.

The effects from an anomaly on the launch pad or downrange would be as described for Concept A. Wildlife in any burn areas could be displaced, killed, or otherwise affected by such a fire. Impacts from acid deposition would be similar to those described previously.

Threatened and Endangered Species. Concept B may potentially affect species protected under the federal Endangered Species Act, the Migratory Bird Treaty Act, and the Bald and Golden Eagle Protection Act. Compliance with these acts would be required as described in Section 4.14.1.1.1.

SLC-37 is near a sea turtle nesting beach. Security lighting at the SLC should be low-pressure sodium fixtures in accordance with the 45 SW exterior lighting policy. A Light Management Plan would need to be prepared in accordance with the USFWS requirements for that complex.

SLC-37 is also adjacent to the beach, which is habitat for the southeastern beach mouse, a species federally listed as threatened. The flame duct points directly over 0.25 to 0.5 acre of this habitat and may impact this species during a launch by direct mortality of individuals from fire and heat, especially during night launches, when this species is active.

Gopher tortoises were found on SLC-37 and the HIF site. Their burrows are in areas planned for construction and would be impacted by the action. Those not directly impacted by construction would be impacted when the launches begin. Other listed species that may reside within these burrows include the eastern Indigo snake, the beach mouse, and the gopher frog. These species could also be affected by construction or launch effects.

Clearing the 14-acre HIF site could impact numerous species, including the Florida scrub jay and those mentioned for SLC-37. The numbers of scrub jays are in a regional decline as a result of habitat loss and degradation due to fire suppression (Myers, 1990; Cox, 1987; and Cox, 1984). In a 1997 Florida scrub jay survey that determined the presence, density, and distribution of Florida scrub jays on the HIF site and in the SLC-37 area, only one pair was observed across the road from the HIF, although the HIF area is most likely part of the territory (Earth Tech, 1997). The areas along road shoulders that would be cleared to accommodate utility lines contain mostly Brazilian pepper, an introduced, aggressive, weedy species. Clearing this vegetation would provide openings in the scrub that would support scrub jay foraging.

Unless a scrub jay is directly in line with the flame trench, immediate mortality of scrub jays seldom occurs from current Titan IVB launches at SLCs 40 and 41. Some road mortality has been noted for scrub jays that occupy territories along the highway (Larson et al., 1993). In the 1997 scrub jay survey of SLC-37, four groups of birds were noted around the perimeter of the SLC (Earth Tech, 1997). Given the distribution of habitat and known scrub jay pairs within the area, it is expected that use of the SLC will not greatly impact Florida scrub jay territories. Project-related clearing of the SLC area inside the perimeter road will only serve to increase areas available for acorn caching. Fire and heat from launches would reduce cover in the area immediately surrounding the SLC, which would be favorable for the scrub jay. The direct impacts of the launch noise and flame could cause incidental mortality; however, because scrub jay territories are maintained at SLCs 40 and 41 during launches without an observable adverse effect on the population, no adverse effect on scrub jays at SLC-37 would be expected. No noticeable effects on scrub jays from the acid cloud were observed from these launches.

The effects from an anomaly would be as described for Concept A. The surrounding scrub jays would be temporarily displaced by a fire. Scrub jay nests could be destroyed if fires occur during the nesting season, but the scrub jays would experience a long-term benefit from the opening up of overgrown habitat as the result of fire and the regrowth of the burned habitat.

Other species that could be affected by an anomaly are the beach mouse and gopher tortoise commensal species, such as the eastern indigo snake, which would be affected by the blast or by the fire and smoke. Acid cloud effects on vegetation and wildlife would be less than those described for the space shuttle.

Sensitive Habitats. Wetlands would be impacted from construction of facilities within SLC-37 and the HIF (ENSR Corporation, 1997c). At the HIF site, 0.68 acre of jurisdictional wetlands could be filled during construction. This wetland is a swale surrounded by scrub and has been impacted by changes in the natural hydrology.

At SLC-37, wetland delineations have identified a jurisdictional drainage ditch wetlands that surrounds the SLC and empties into the Banana River. New utility corridors to the SLC may cross the ditch, and their installation would constitute a wetland impact. Within the SLC, 7 acres of vegetated drainage ditches connect to the jurisdictional wetland ditch surrounding the SLC. Approximately 2 acres of these surface waters may be impacted as a result of proposed development. Impacts to these waters, as well as to the wetlands, would require the appropriate permits, as described in Section 4.14.1.1.1.

Contact with the acid cloud could be expected to irritate or annoy birds in the rookeries along the Banana River; however, solid rocket motor launches occur in the vicinity, and animals sensitive to these launches would most likely have moved elsewhere. Manatee critical habitat is not expected to be adversely affected by acid deposition because of the diluting effects of the water.
An anomaly could cause effects as described under Concept A. Although fire could benefit overgrown coastal scrub or wetlands by clearing duff and recycling nutrients, uncontrolled burns could adversely affect species using these habitats if fire occurs during sensitive seasons, such as Florida scrub jay nesting season. An anomaly could cause an acid cloud in the vicinity of the launch pad; however, effects would be less than those described for space shuttle launches.

Mitigation Measures. Mitigation for sea turtle nestling lighting impacts would be as described in Section 4.14.1.1.2.

Impacts to the southeastern beach mouse may be mitigated though a trapping effort to relocate the mice and through habitat restoration (clearing scrub) near the site. The final methods would be determined through formal consultation with the USFWS.

Any construction activities affecting Florida scrub jay habitat would be coordinated with USFWS. Specific mitigations may be developed during Endangered Species Act Section 7 consultation, and could include the following measures. To the extent possible, construction activities would occur between July 1 and February 29 to avoid the nesting season. If the nesting season cannot be avoided, surveys should be conducted one to two days prior to construction to identify any nests present in or around the construction site. If no nests are present in the construction area, or within 50 to 75 feet surrounding the area to be cleared, construction may proceed. Vegetation clearing would be limited to that absolutely necessary for the project (U.S. Air Force, 1993a). Scrub clearance would be followed by habitat compensation mitigation activities as outlined in the Scrub Jay Habitat Compensation Plan for Cape Canaveral AS, which requires restoration of 3 acres of scrub to compensate for the loss of each acre of scrub jay habitat. Areas that are extremely degraded may also be planted with live oak, myrtle oak, and Chapman's oak seedlings. A 5-year monitoring program, including oak seedling replacement and weed control as required, would accompany any scrub jay habitat restoration activities (U.S. Air Force, 1993a). Removal of abandoned pavement and revegetation of these areas with scrub, and the clearing of densely vegetated areas previously containing scrub jay habitat, are some of the actions considered for compensation. Disturbed road shoulder areas should be replanted with native grasses, not with sod, to allow the scrub jays to utilize small patches of open sand for acorn caches.

The clearing of overgrown scrub jay habitat could also be considered as wetland restoration because it would benefit the swale wetlands in the area. Swale-overgrown vegetation would be cleared to compensate for wetlands impacted by the project at a ratio of 1 to 1. The selected mitigation site is adjacent, south of SLC-37. Use of a hydroaxe for brush clearing, followed by a prescribed burn, is recommended. The proposed parcel contains 5 acres of degraded wetlands and will exceed mitigation requirements set by the USACE. Mitigations compensating for drainage ditch wetland impacts will not be required.

Prior to construction, a biological survey would be conducted to identify existing gopher tortoises on the site. These tortoises would be trapped and removed from the area to the scrub jay mitigation site after all mitigation activities are complete, prior to the clearing of any construction site. Necessary permits for handling tortoises would be obtained from the Florida Game and Freshwater Fish Commission. Additional mitigative actions, if necessary, would be identified by the USFWS through the Section 7 consultation process (U.S. Air Force, 1993). Gopher tortoise burrows create habitat for a number of sensitive species; relocation of the tortoises would facilitate creation of habitat for these species at other locations. Relocation of the species that use the tortoise burrows is not always feasible but could be conducted as appropriate.

Mitigation parameters for wetland impacts would generally be as described in Section 4.14.1.1.2. Enhancement of degraded wetlands may be required as mitigation for wetlands impacts, at a ratio of 1 to 1. The site for wetlands mitigation would be the same as for the scrub jay habitat mitigation (ENSR Corporation, 1997c).

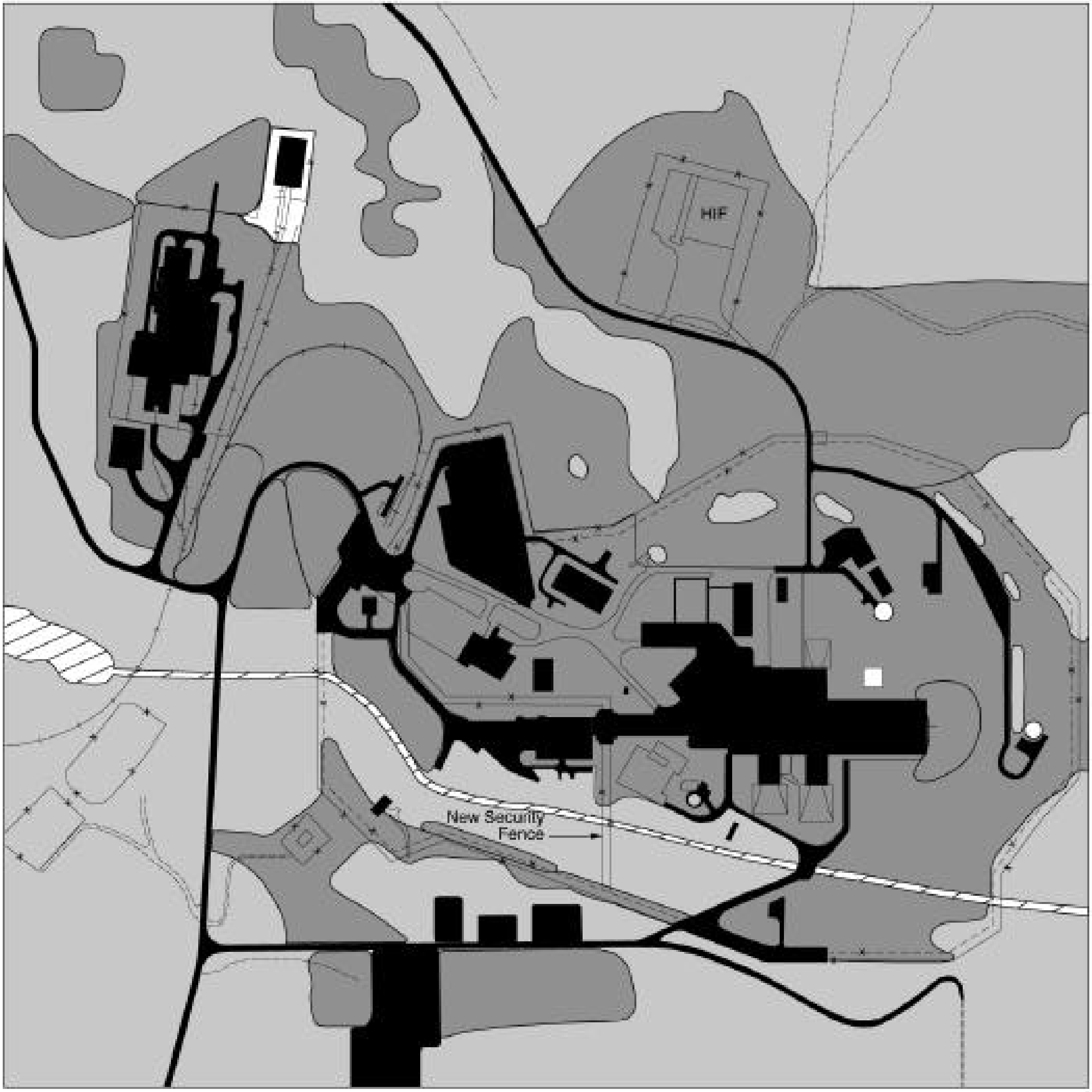
Monitoring of pre- and post-launch effects of acid cloud deposition on the nearby resident plant and animal species could provide information concerning long-term effects and potential protective measures.

4.14.1.2.2 Concept B, Vandenberg AFB. At Vandenberg AFB, potential impacts to biological resources from Concept B could occur from ground-disturbing activities at and adjacent to SLC-6, from dredging activities at the boathouse dock, and from launch activities from SLC-6. All other facilities would be used as standing, or the modifications would be either internal to the building or on a concrete apron outside of the building. Biological resources impacts would not be expected from use of these facilities.

Figure 4.14-4 shows the locations of vegetation and sensitive habitat associated with proposed construction at SLC-6.

Some of the launches would utilize solid propellants whose combustion produces an acid cloud at launch.

Vegetation. Vegetation disturbance would be minimal for this concept. Areas planned for facility disturbance are either bladed road shoulders, mowed grasses and forbs, or weedy parking areas. Vegetation would be affected by the installation of a fence at SLC-6 and by direct effect of the launches (i.e., burning, defoliation, near-field deposition).



EXPLANATION

- Double Fence (If required)
- Security Fence
- HIF Horizontal Integration Facility
- Developed
- Barren
- Coastal Sage Scrub
- Grassland
- Wetland
- New proposed facilities

0 145 290 580 Feet

Source: Bionetics Corporation, 1988; site visit, 1997.

SLC-6 Vegetation and Sensitive Habitat Vandenberg AFB, California

Figure 4.14-4

EEL/110

A fence would be constructed through native vegetation. For security (visibility) purposes, vegetation would be cleared for 30 feet on either side of the fence, for a length of 200 feet. The vegetation along a portion of this fence is a pristine coastal sage scrub community with former Category 2 plants such as Indian paintbrush and dudlea. The vegetation could be affected by fence construction. Effects to vegetation from launches, acid cloud deposition, and launch anomalies would be the same as those summarized under Concept A for Vandenberg AFB (specific vegetation effects) and under Concept B for Cape Canaveral AS (acid cloud effects).

Wildlife. Wildlife would be temporarily displaced during construction and other ground-disturbing activities, but the effect to the wildlife population would be negligible because sufficient suitable habitat is available nearby. The primary effects to wildlife would occur during the launch activities.

The impacts to open-ocean species from direct ocean impacts, and to general wildlife species from pre-launch control aircraft overflights and direct effect of launches, would be similar to those described under Concept A for Vandenberg AFB. In addition, general sonic boom studies and specific studies have been conducted for the species on Vandenberg AFB and the Channel Islands.

Physiological and behavioral response to sonic booms and launch noise on birds and pinnipeds of California would be similar to those described in Section 4.14.1.1.3. SLC-6 is farther from the Point Sal and Purisima Point haul-out and nesting areas than SLC-3, although it is directly adjacent to the Rocky Point site. However, birds and pinnipeds continue to use these areas near SLC-2, even though launches are conducted there, so no long-term adverse effects on these species or their habitats are anticipated from EELV launches from SLC-6.

The permitting requirement for the harassment of marine mammals is described in Section 4.14.1.1.3.

The area by the boathouse designated for dredging was dredged in the mid-1980s. Clearing of this area could remove algae (seaweed) or surfgrass and cause siltation impacts to adjacent invertebrates. Although some individuals may be removed or buried, these invertebrate populations are not expected to be adversely affected by this siltation. Fish species present near Point Arguello would leave the area during dredging activities, as would any seals, sea lions, or sea otters that may be visiting the channel. Long-term effects to these species are not expected.

The deposition of dredged material would cause the greatest impact. When the site is chosen for deposition, it should be inspected for species impacts before disposal is implemented.

Solid propellant causes an acid cloud during launch. Fish kills have been noted from near-field space shuttle launch effects (Knott et al., 1983, Milligan and Hubbard, 1983, Hawkins et al., 1984). Although the effects are not expected to be as severe as those from the space shuttle because of the smaller acid cloud that would be produced by the EELV, temporary increases in acidity in the surface waters surrounding the launch site would be expected, and fish kills could occur. Acid deposition in the nearby Cañada Honda Creek could have adverse impacts on aquatic species that live there. A beneficial effect of terminating solid rocket motor launches under current programs would be cessation of acid deposition effects on sensitive least tern and snowy plover nesting areas near SLC-2.

An anomaly would cause effects as described for Concept A. Cañada Honda Creek and its associated wildlife is closer to SLC-6 than to SLC-3 and could be adversely affected as well. Acid cloud deposition would be more intense for an anomaly than for a nominal launch, and could affect species in Cañada Honda Creek or Jamala Creek.

Threatened and Endangered Species. Helicopter security overflight effects in support of EELV launches would be as described in Section 4.14.1.1.3.

Effects of SLC-3 launches and low-altitude overflight of aircraft during pre-launch security patrols on willow flycatchers along the Santa Ynez River would be minimal, as described in Section 4.14.1.1.3. SLC-6 is located farther from the Santa Ynez River than SLC-3W, and launches from SLC-6 would be expected to have less impact on this species than launches from SLC-3W.

Least terns at the Purisima site show a significant impact from Delta II launches from SLC-2. Effects of EELV launches from SLC-6 would not be as great because the launch site is located much farther from the Purisima site than SLC-2. The EELV program would benefit the Purisima Point least tern population because launches from SLC-2 would be terminated.

General impacts to peregrine falcons from launch activities are described in Section 4.14.1.1.3. Because SLC-6 is much closer to the peregrine's nesting area than SLC-4, the potential for impacts from EELV launches from SLC-6 is greater than for Titan IVB from SLC-4. Launching during the nesting season could cause the nearby nests to fail, due to possible nest abandonment or from a startle response that could injure or kill the young.

Potential general impacts from launch noises to the unarmored threespine stickleback and the tidewater goby are described in Section 4.14.1.1.3.

The negligible impacts on southern sea otter from South Vandenberg AFB launches are described in Section 4.14.1.1.3.

The acidic emissions caused by solid rocket boosters could affect the shallow Cañada Honda Creek. The tidewater goby, the unarmored threespine stickleback, and the red-legged frog inhabit the creek and could be adversely affected by acidification of the water. These impacts would be similar to those experienced under the current launch programs.

Impacts from an anomaly would be as described under Wildlife. Sensitive species residing in the surrounding cliffs could be injured or killed from the explosion.

Sensitive Habitats. An arroyo wetland has been identified on SLC-6. Construction of a security fence would disturb this wetland, affecting a wetland area approximately 25 feet long by 60 feet wide (0.03 acre).

Disturbance of the wetland would likely require a Section 404 Fill Permit and a FONPA. HCl and aluminum oxide deposition could harm species living in the wetland as described under Vegetation and Wildlife.

The Channel Islands are also a sensitive habitat; potential impacts to them have been discussed under Wildlife. Shorebird nesting occurs along the coast of Vandenberg AFB and is disturbed by launches from South Vandenberg AFB to as far north as SLC-2W. However, launching occurs out of SLC-2W, and the shore birds continue to use the area; consequently, no long-term adverse impacts from EELV launches would be expected.

The dredging of the boathouse channel would have to be authorized by Section 10 of the Rivers and Harbors Act of 1899, Section 404 of the CWA, and Section 103 of the Marine, Protection, and Sanctuaries Act. These laws require permits authorizing activities in or affecting navigable Waters of the United States, the discharge of dredged or fill material into Waters of the United States, and the transportation of dredged material for the purpose of dumping it into ocean waters. This site was originally dredged in the mid-1980s and was authorized to be maintained at 12.4 feet below MSL through June 1989, although plans as stated on the permit include dredging as needed through 1998. The spoil disposal site in the ocean was a deep canyon with a high degree of instability where land slumped off the canyon walls naturally and fell to the canyon bottom. It was thought that additional sand debris would not greatly impact the canyon's ecology (U.S. Air Force, 1982b). Areas of biological importance, such as spawning grounds, are far from the canyon and are not thought to be affected by the disposal. In the latest permit (1988), the dredged sand was to be trucked to a borrow site located along the coastal bluffs at Point Pedernales. Although it has not yet been determined whether the 20,000 cubic yards of spoils will be disposed on dry land as stipulated in the 1988 permit, or in the ocean as was conducted in the mid-1980s, the amount of dredging and dredged materials is approximately one-third of that originally dredged and is not expected to cause a serious impact.

Butterfly trees are present near SLC-6, and the visiting monarch butterflies could be affected by the acid cloud if a launch occurs when the butterflies are congregating (November through February). Offshore or southerly wind directions during the launch could blow the acid cloud away from the butterfly trees; onshore or northerly winds could blow the cloud directly over the trees.

Impacts from an anomaly would be as described for Concept A, and could affect sensitive species and habitat along Cañada Honda Creek and in the cliffs surrounding SLC-6.

Mitigation Measures. Impacts to the native upland vegetation at SLC-6 for the fence installation would require replacement at a ratio of 3 to 1, consistent with the Santa Barbara County policy for impact mitigation (Gillespie, 1997).

Numerous special conditions were added to the original dredge permit for the boat dock. These conditions included pre-, during, and post-surveys of flora and fauna to determine if the dredging caused changes in the rocky inter- and subtidal, and sandy regions; providing a qualified biologist on site to ensure that a minimal amount of physical impacts occur during the dredging to mammals and birds; notifying appropriate organizations of planned activities; and planting red abalone in rocky habitat adjacent to the boathouse area.

Studies conducted before, during, and after Titan IVB launches from SLC-4 in May and December 1996 resulted in several recommended mitigations for future monitoring of sensitive species. These are discussed in Section 4.14.1.1.3.

Mitigation measures that could be implemented for the wetland that would be disturbed by the SLC-6 fence installation are summarized in Section 4.14.1.2.2. Specific mitigation requirements for wetland impacts on Vandenberg AFB may include creation of new wetlands rather than restoration of existing wetlands. Wetland mitigations required for this fence installation would be determined during the permit application process for the Section 404 CWA wetland fill permit, and a FONPA will be prepared by the Air Force, as required under EO 11990.

Monitoring of water quality in Cañada Honda Creek should be continued to assess effects to sensitive species and habitats.

4.14.1.3 Concept A/B

4.14.1.3.1 Concept A/B, Cape Canaveral AS. Impacts from launch effects and anomalies would be as similar to the combined effects described for Concepts A and B because most of the launch effects are measured more by single events than by number of launches, providing the launches are spread apart to allow wildlife to resettle and acid deposition to dissipate. Construction effects would also be the combined effects of both concepts and would be greater than for either concept individually.

Impacts to vegetation and wildlife from this concept's construction requirements would be similar to the combined effects described for Concepts A and B. No regionally sensitive vegetation community or wildlife would be affected in important amounts.

Impacts to threatened or endangered species would include effects described for both Concept A and B to the Florida scrub jay, the Florida beach mouse, the American alligator, and two state-listed plants. However, these effects are not considered significant for any single species. Concept A/B could disturb 0.68 acre associated with the SLC-37 HIF site and 8.2 acres at the assembly facility near SLC-41, resulting in disturbance of a total of 8.88 acres of wetlands under Concept A/B. Mitigations would be the same as those described in Sections 4.14.11.1 and 4.14.1.2 for Concepts A and B.

4.14.1.3.2 Concept A/B, Vandenberg AFB. Impacts from construction activities, launch operations, and anomalies would be a combination of the effects described for Concepts A and B. Concept A/B activities could disturb 0.03 acre associated with the SLC-3W site and 0.03 acre near SLC-6, resulting in disturbance of a total of 0.06 acre of wetlands under Concept A/B. Mitigations would be the same as described for Concepts A and B in Sections 4.14.1.1 and 4.14.1.2.

4.14.2 No-Action Alternative

4.14.2.1 Cape Canaveral AS

The solid rocket motors used in some existing launch vehicles produce an HCl/aluminum oxide cloud that affects the nearby ecosystem as described for Concept B in Section 4.14.1.2.1. In addition, direct effects from launches on vegetation at these SLCs (e.g., burning of vegetation, defoliation from heat) and impacts to wildlife from launch noises, pre-launch control aircraft and rocket overflights, sonic booms, and impact of rocket debris in the open-ocean area from these launch programs would continue and would be similar to the impacts described for Concepts A and B.

4.14.2.2 Vandenberg AFB

The solid rocket motors used in some existing launch vehicles produce an HCl/aluminum oxide cloud that adversely affects the nearby ecosystem. The northern site would continue to operate launches in a location adjacent to sensitive species, including the endangered California least tern, the brown pelican, the threatened western snowy plover, and the southern sea otter, although this northern location avoids most impacts to the Channel Islands. An anomaly at this location could potentially affect the sensitive adjacent species from heat, fire, and the percussive effects of the explosion and falling debris. In addition, direct effects from launches on vegetation at these SLCs (e.g., burning of vegetation, defoliation from heat), and impacts to wildlife from launch noises, pre-launch control aircraft and rocket overflights, sonic booms, and impact of rocket debris in the open-ocean area from these launch programs would continue and would be similar to the impacts described for Concepts A and B.

4.15 CULTURAL RESOURCES

4.15.1 Proposed Action

4.15.1.1 Concept A

4.15.1.1.1 Concept A, Cape Canaveral AS

Prehistoric and Historic Archaeological Resources. Concept A at Cape Canaveral AS encompasses portions of land around SLC-41 that are under the jurisdiction of either Cape Canaveral AS or the KSC. Both installations have completed archaeological surveys and inventories that satisfy the requirements of Section 110 of the NHPA. Each installation has identified numerous prehistoric and historic sites and established archaeological sensitivity zones for those areas not intensively surveyed (New South Associates, 1996). Cape Canaveral AS cultural resources managers have consulted with the Florida SHPO, and the SHPO has concurred that ground-disturbing activities that take place outside of recorded site boundaries and the sensitivity zones require no additional study (see Appendix I). KSC cultural resources policy directs that additional studies be conducted when direct ground-disturbing activities have the potential to affect archaeologically unevaluated areas.

There are no National Register-listed or -eligible prehistoric or historic archaeological sites or archaeologically sensitive areas within the direct ground disturbance footprints for Concept A (i.e., areas of facility and utility line construction and roadway modification) within the ROI. Recent archaeological studies encompassing the ROI for the two proposed assembly facilities indicate that two previously identified mounds are non-aboriginal and that no other cultural remains are present (Archaeological Consultants, Inc., 1997). As a result, no effects on archaeological resources are expected to occur from construction activities associated with the EELV program under Concept A.

Because of the remote possibility that an on-pad or missile storage mishap could occur, an ROI around SLC-41 and the proposed assembly facility sites has been assumed. Within these areas, one prehistoric site (8BR914) that is potentially eligible for inclusion in the National Register (see Appendix I) and a portion of an archaeologically sensitive area were identified; both are located on land that is under the jurisdiction of the KSC.

Historic Buildings and Structures. None of the buildings and structures identified for EELV activities is under the jurisdiction of the KSC.

Facilities at Cape Canaveral AS requiring modification under Concept A include SLC-41 (encompassing numerous individual buildings and structures completed by 1965), Hangar J (Building 1721, constructed in 1956), and Buildings 38804 and 38835 in the CPF complex. Both SLC-41 and Hangar J were recently assessed for their eligibility for inclusion in the National Register. However, because of their age, their lack of association with events or persons significant in history, their unremarkable architecture or design, and their unlikely ability to meet the exceptional criteria required under National Park Service Criteria Consideration G for properties less than 50 years in age, it is unlikely that either facility would meet the required National Register-listing criteria. In addition, the modification of Hangar J is minor and interior only. Of the numerous features within SLC-41, only a few (i.e., the MST, the Umbilical Tower, and the SEB) require substantial modification or removal. Buildings 38804 and 38835 have only recently been constructed and will be modified for EELV activities before final completion and acceptance by the Air Force.

Consultation with the Florida SHPO is in progress; results of the consultation will be presented in the FEIS.

Native Populations/Traditional Resources. Two Native American tribes have expressed interest in the cultural resources environment in the ROI: the Seminole Indian Tribe and the Micosukee Indian Tribe. Although no traditional resources sites have been identified within the ROI, these groups will be contacted during the EIS preparation process to ensure that their concerns regarding the EELV program are considered.

Mitigation Measures, Cape Canaveral AS

Prehistoric and Historic Archaeological Resources and Traditional Resources. Because no National Register-listed or -eligible prehistoric or historic archaeological resources or traditional resources have been identified within the direct ground disturbance ROI for Concept A, no mitigation measures have been identified. However, if during the course of program activities, cultural materials (particularly human remains) are unexpectedly discovered, work in the immediate vicinity of the cultural materials would cease and the Florida SHPO would be consulted through the Cape Canaveral AS Environmental Offices (see Appendix I). Subsequent actions would follow guidance provided in Title 36 CFR 800.11 and/or in NAGPRA.

Mitigation measures to offset potential effects on archaeological/traditional resources from an on-pad or missile storage mishap are not proposed because the probability of such an occurrence is low and the cost of the mitigation (e.g., data recovery) is high. In the unlikely event that a mishap occurs, post-event recommendations include survey, mapping, photography, and site record revisions to determine and record the extent of damage from impacts or fire.

Historic Buildings and Structures. Determination of the historical significance of SLC-41 and Hangar J is pending. Mitigation measures would be developed during consultation with the Florida SHPO.

4.15.1.1.2 Concept A, Vandenberg AFB

Prehistoric and Historic Archaeological Resources. Within the direct ground-disturbance footprints for Concept A (i.e., areas of facility and utility line construction and roadway intersection/building entrance modification), no National Register-listed or -eligible prehistoric or historic archaeological sites have been identified. However, in one proposed project location (the corner of Bear Creek and Coast roads), a National Register-eligible site does occur within close proximity to ground-disturbing activities.

The immediate project area at the corner of Bear Creek and Coast roads has been previously surveyed, and no sites have been recorded. This area is also very heavily disturbed from the installation of several communications and light poles and the recent replacement of large underground water pipes. Several archaeological sites are near this area, however, and one is eligible for inclusion in the National Register (Site SBA 534) (see Appendix I). Site SBA 534 is just south of the construction area where a power pole would be raised. Discussions with Vandenberg AFB cultural resources managers indicate that because of the proximity of this site to the ground-disturbing activities, archaeological and Native American monitoring would be required.

In addition, because of the remote possibility that an on-pad mishap could occur, an ROI around SLC-3W has been assumed. Within this area, 11 archaeological sites have been identified; a recent review of archaeological site records indicates that none of the sites is eligible for inclusion in the National Register.

As a result of the lack of National Register-eligible or -listed sites within the direct construction areas and the ROI, and the proposed mitigation monitoring at the intersection of Bear Creek and Coast roads, no adverse effects on archaeological resources are expected to occur from EELV program activities under Concept A. Except as already noted, consultation with Vandenberg AFB cultural resources managers indicates that no archaeological/Native American monitoring would be required at any of the ground-disturbing areas.

Historic Buildings and Structures. Facilities at Vandenberg AFB requiring modification under Concept A include SLC-3W, encompassing numerous individual buildings and structures completed between 1956 and 1959. SLC-3 (East and West) and all of its associated support facilities have been evaluated for inclusion in the National Register and determined to be eligible under the Cold War historic context as a “highly technical and scientific” facility. SLC-3W contributing features include the Launch and Service Building (Building 770), the MST, the Umbilical Tower, the retention basin, and the deluge channel. The Launch Operations Facility (Building 763) and the Launch Vehicle Support Facility (Building 766) are also contributing as “shared” facilities with SLC-3E.

The typical mitigation for potential adverse effects on historic buildings and structures (i.e., demolition, modification, damage from on-pad mishap) is recordation using standards developed by the HABS/HAER. HABS/HAER recordation of SLC-3 (East and West) was completed in 1993.

Native Populations/Traditional Resources. The only Native American tribe affiliated with the area encompassed by Vandenberg AFB is the Chumash Indian Tribe. No traditional resources sites have been identified within the Concept A ROI; however, the Santa Inez Band of Chumash Indians will be contacted during the EIS preparation process to ensure that their concerns regarding the EELV program are considered.

Paleontological Resources. There are no recorded fossils or National Natural Landmarks within the immediate vicinity of SLC-3 or any of the other proposed ground-disturbing areas within the Concept A cultural resources ROI; therefore, no effects are expected.

Mitigation Measures, Vandenberg AFB

Prehistoric and Historic Archaeological Resources and Traditional Resources. Monitoring by a professional archaeologist and a Native American representative from the Santa Inez Band of Chumash Indians would be required during intersection modifications (road widening and the raising of power poles) proposed for the northeast and southeast corners of Bear Creek and Coast roads. No other cultural resources mitigation measures have been identified under Concept A at Vandenberg AFB. However, if during the course of any EELV program activities, cultural materials (particularly human remains) are unexpectedly discovered, work in the immediate vicinity of the cultural materials would cease and Vandenberg AFB cultural resources managers would be notified immediately.

4.15.1.2 Concept B

4.15.1.2.1 Concept B, Cape Canaveral AS

Prehistoric and Historic Archaeological Resources. Numerous prehistoric and historic sites and a large archaeological sensitivity zone (primarily along the Banana River) have been established for the portions of the APE that have not been intensively surveyed (New South Associates, 1996). Cape Canaveral cultural resources managers have consulted with the Florida SHPO who has concurred that ground-disturbing activities that take place outside of recorded site boundaries and the sensitivity zone require no additional study (see Appendix I).

There are no National Register-listed or -eligible prehistoric or historic archaeological sites or archaeologically sensitive areas within the direct ground disturbance footprints for Concept B (i.e., areas of facility and utility line construction and roadway intersection/facility entrance modification). As a result, no effects on archaeological resources are expected to occur from construction activities associated with the EELV program.

Because of the remote possibility that an on-pad mishap could occur, an ROI around SLC-37 has been assumed. Within this area, six archaeological sites have been identified; three of the sites (8BR82A, 8BR83, and 8BR221) are potentially eligible for inclusion in the National Register; the remaining sites are not eligible (see Appendix I).

Historic Buildings and Structures. Facilities at Cape Canaveral AS requiring modification under Concept B include SLC-37 (encompassing numerous individual buildings and structures completed by 1962 [including Buildings 38315, 43302, and 43400]); Hangar C (Building 1348, constructed in 1953); the MIS (Building 75251, constructed in 1964); Buildings 38800, 38804, and 38835 within the CPF complex, and the Air Force Roll-on Roll-off Dock (Structure 92050, constructed in 1956) (alternative to use of the Port of Canaveral dock). Under Concept B, launch activities may also require abandonment of Buildings 33001, 33003, 33007, 33009, 38320, 43401, 43403, and 43405, all of which are support structures associated with SLC-37.

SLC-37 and all associated support facilities have been evaluated for inclusion in the National Register and determined to be ineligible (New South Associates, 1996). The MIS and the Air Force Roll-on Roll-off Dock have been recently assessed for possible inclusion in the National Register. However, because of their age, their lack of association with events or persons significant in history, their unremarkable architecture or design, and their unlikely ability to meet the exceptional criteria required under National Park Service Criteria Consideration G for properties less than 50 years in age, it is unlikely that these facilities would meet the required National Register-listing criteria.

Hangar C has also been recently assessed for possible inclusion in the National Register. Historical research indicates that there is some potential for this facility to possess historical significance based on its association with Werner von Braun and its function as a checkout and assembly facility for several early types of rockets (e.g., Matador, Snark, Bomarc). Proposed exterior modifications to this facility include rust removal around hangar doors, re-hanging of broken personnel doors, and construction of new entrance canopies over the east and west personnel entrances. Interior modifications include asbestos removal; lead-based paint abatement (probably by over-painting); installation of new lighting and power distribution, suspended ceiling, doors, and HVAC; removal of drywall partitions, refurbishment of stairwells, and painting.

The Air Force will consult with the Florida SHPO regarding the eligibility of these facilities and any required mitigation measures.

Native Populations/Traditional Resources. Two Native American tribes have expressed interest in the cultural resources environment in the ROI: the Seminole Indian Tribe and the Micosukee Indian Tribe. Although no traditional resources sites have been identified within the ROI at Cape Canaveral AS, these groups will be contacted during the EIS preparation process to ensure that their concerns regarding the EELV program are considered.

4.15.1.2.2 Mitigation Measures, Cape Canaveral AS

Prehistoric and Historic Archaeological Resources and Traditional Resources. Because no National Register-listed or -eligible prehistoric or historic archaeological resources or traditional resources have been identified within the direct ground disturbance ROI for Concept B, no mitigation measures have been identified. However, if during the course of program activities, cultural materials (particularly, human remains) are unexpectedly discovered, work in the immediate vicinity of the cultural materials would cease and the Florida SHPO would be consulted through the Cape Canaveral AS Environmental Office (see Appendix I). Subsequent actions would follow guidance provided in Title 36 CFR 800.11 and/or in NAGPRA.

Mitigation measures to offset potential effects on archaeological/traditional resources from an on-pad or missile storage mishap are not proposed because the probability of such an occurrence is low and the cost of the mitigation (e.g., data recovery) is high. In the unlikely event that a mishap occurs, post-mishap recommendations include post-event survey, mapping, photography, and site record revisions to determine and record the extent of damage from impacts or fire.

Historic Buildings and Structures. The historical significance of Hangar C, the MIS, and the Air Force Roll-on Roll-off Dock is pending. Mitigation measures would be developed during consultation with the Florida SHPO.

4.15.1.2.3 Concept B, Vandenberg AFB

Prehistoric and Historic Archaeological Resources. All of the direct ground disturbance areas under Concept B would take place at SLC-6, which is an archaeologically sensitive area. Numerous sites have been recorded within the fenceline of SLC-6, as well as adjacent to the complex, and 15 sites have been recorded within the cultural resources ROI for the EELV program; 6 of the 15 sites have been recommended as eligible for inclusion in the National Register.

Of the ground disturbance proposed for SLC-6, only construction of the HIF has the potential to directly affect an archaeological site (Site SBA 2032). Results of recent surface and subsurface studies of SBA 2032 (ENSR Corporation, 1997a) indicate that the site is heavily disturbed and deeply buried and not likely to be affected by HIF construction. However, recommendations developed in consultation with Vandenberg AFB cultural resources managers indicate that any earth disturbance in the southeastern quarter of the HIF project area should be monitored by an archaeologist and a representative from the Santa Inez Band of Chumash Indians. In addition, if the HIF construction area changes to include the North Access Road lower parking lot, Vandenberg AFB cultural resources managers are to be notified and a subsurface testing program undertaken to determine the presence or absence of SBA 2032-associated cultural materials.

As proposed, the remaining ground-disturbing activities associated with Concept B (e.g., installation of the security fence) do not threaten known archaeological sites. However, since the entire SLC 6 area is archaeologically sensitive, Vandenberg AFB cultural resources managers have requested that archaeological and Native American monitoring be conducted during all ground-disturbing activities in that area. Any ground disturbance around Building 398, which is immediately adjacent to SLC 6, would also require monitoring (ENSR Corporation, 1997a).

Archaeological surveys of Vandenberg AFB include an underwater study of the South Vandenberg AFB Point Arguello boathouse harbor (U.S. Department of the Interior, National Park Service, 1978). The study did not identify any underwater sites and indicated that no additional studies would be necessary. As such, dredging of the boathouse harbor would have no effect on underwater archaeological resources.

Historic Buildings and Structures. Facilities at Vandenberg AFB requiring modification under Concept B include SLC-6 (encompassing numerous individual buildings and structures completed by 1966) and Buildings 330, 375, 396, 520, 636, 1032, and 1670. None of these facilities is eligible or potentially eligible for inclusion in the National Register; therefore, no effects on historic buildings and structures are expected to occur.

Native Populations/Traditional Resources. The only Native American tribe affiliated with the area encompassed by Vandenberg AFB is the Chumash Indian Tribe. No specifically designated traditional resources sites have been identified within the Concept B ROI; however, some of the recorded archaeological sites may represent traditional resources sites or contain traditional resources elements as well. The Santa Inez Band of Chumash Indians will be contacted during the EIS preparation process to ensure that their concerns regarding the EELV program are considered.

Paleontological Resources. There are no recorded fossils or National Natural Landmarks within the SLC-6 ROI; therefore, no effects are expected to occur.

4.15.1.2.4 Mitigation Measures, Vandenberg AFB

Prehistoric and Historic Archaeological Resources and Traditional Resources. Monitoring by a professional archaeologist and a Native American representative from the Santa Inez Band of Chumash Indians will be required during all ground-disturbing activities at SLC-6. No other cultural resources mitigation measures have been identified under Concept B at Vandenberg AFB. However, if during the course of any EELV program activities, cultural materials (particularly, human remains) are unexpectedly discovered, work in the immediate vicinity of the cultural materials would cease and Vandenberg AFB cultural resources managers would be notified immediately.

4.15.1.3 Concept A/B

4.15.1.3.1 Concept A/B, Cape Canaveral AS

Because Concept A/B encompasses the facilities described under both Concepts A and B, effects from EELV activities and any proposed mitigation measures would be similar to the combined effects described in Sections 4.15.1.1 and 4.15.1.2.

4.15.1.3.2 Concept A/B, Vandenberg AFB

Because Concept A/B encompasses the facilities described under both Concepts A and B, effects from EELV activities and any proposed mitigation measures would be similar to the combined effects described in Sections 4.15.1.1 and 4.15.1.2.

4.15.2 No-Action Alternative

4.15.2.1 Cape Canaveral AS

Under the No-Action Alternative at Cape Canaveral AS, SLCs 17, 36, 40, and 41 would continue to support Delta II, Atlas IIA, and Titan IVB launches. SLCs 17 and 36 have been evaluated for inclusion in the National Register and have been determined eligible (see Appendix I). SLC-41 was recently assessed, and a determination of eligibility is pending. SLC-40 has not yet been evaluated. However, because no new construction or facility modifications have been proposed under the No-Action Alternative, no effects on historic properties are expected.

4.15.2.2 Vandenberg AFB

Under the No-Action Alternative at Vandenberg AFB, SLCs 2W, 3E, and 4E would continue to support Atlas IIA, Delta II, and Titan IVB launches. All three complexes have been evaluated for inclusion in the National Register and specific features determined to be eligible (see Appendix I); however, no new construction or facility modifications have been proposed under the No-Action Alternative. Therefore, no effects on historic properties are expected.

4.16 ENVIRONMENTAL JUSTICE

The analysis conducted for this EIS included a review of influencing factors (local community resources) and a discussion of resulting impacts associated with hazardous materials and hazardous waste management and the natural environment. Local community resources (e.g., employment and population, land use and aesthetics, transportation, utilities) have been identified as influencing factors only and therefore would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations.

Based upon the analysis conducted for this EIS, it was determined that activities associated with the Proposed Action would not have adverse effects on low-income and minority populations for any of the resources analyzed in this EIS: hazardous materials and hazardous waste, health and safety, geology and soils, water resources, noise, biological resources, and cultural resources. Air quality impacts would be basin-wide, and orbital debris impacts would be at a global scale; thus, no disproportionately high and adverse air quality impacts to low-income and minority populations would be expected.

THIS PAGE INTENTIONALLY LEFT BLANK